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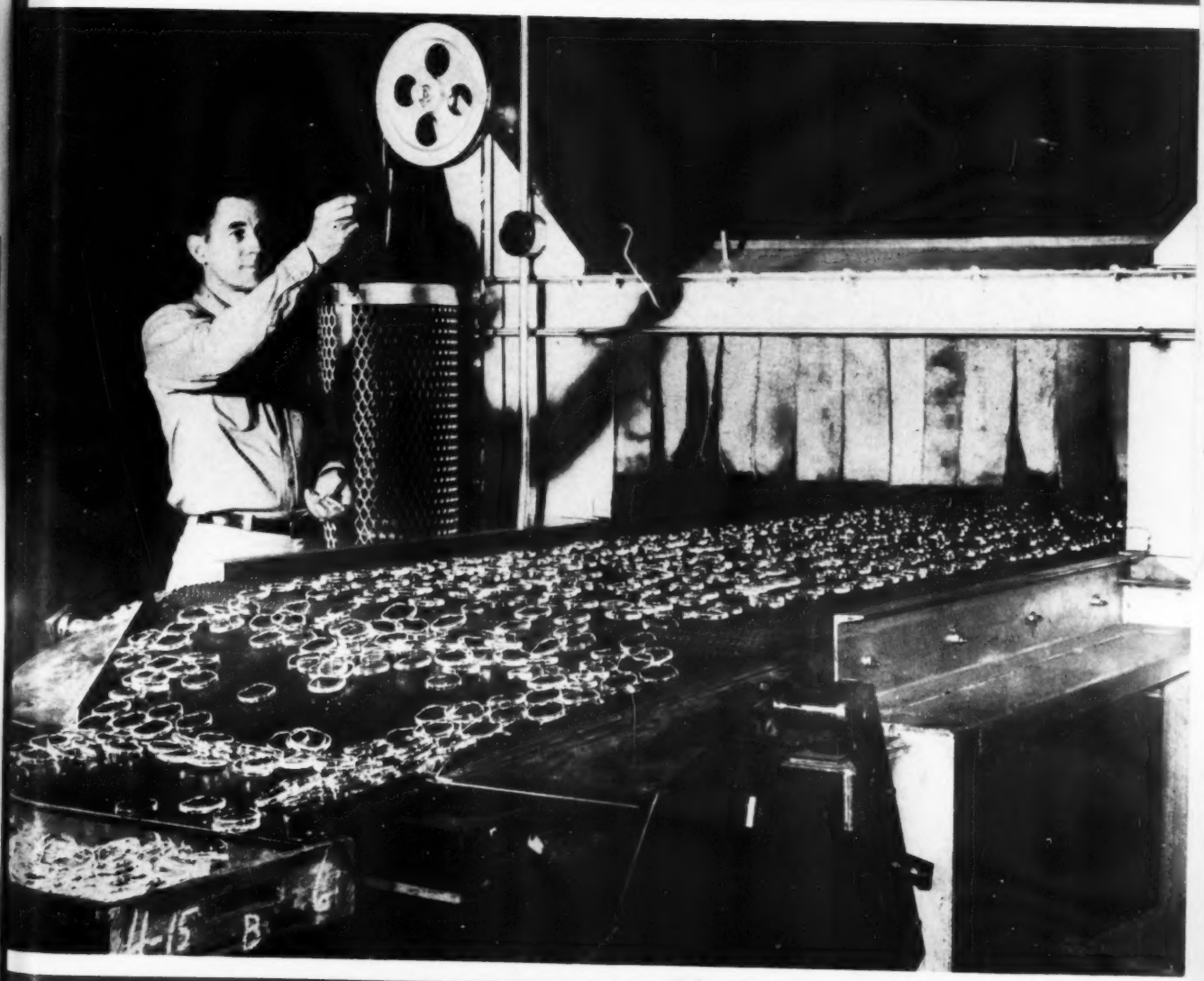
December, 1955

THE JOURNAL OF GLASS MANUFACTURING

the glass industry



Optical glass pressings emerge from the lehr ready for processing into finished lens blanks. *Courtesy Bausch & Lomb Optical Company.*

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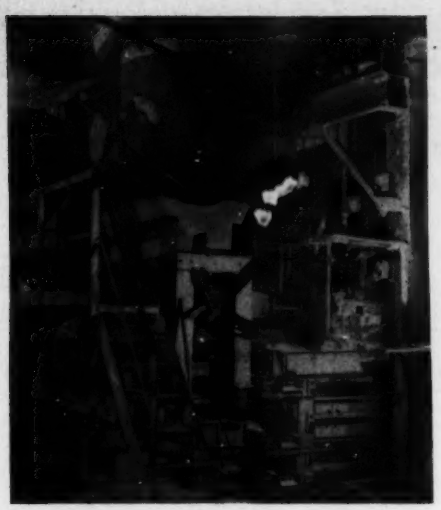

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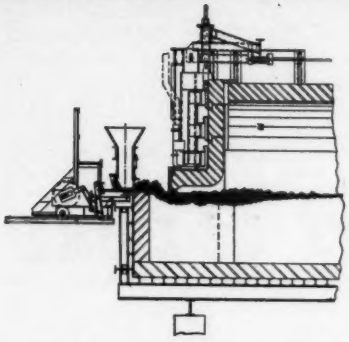

Note the shallow, uniform blanket of fritted batch distributed across the melting chamber.

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the glass industry

CONTENTS FOR DECEMBER : 1955

"Technically Speaking" about the new Owens-Illinois Technical Center ... 627
The story of the facilities, engineering and research processes carried on in this largest glass technical center. By H. H. Holscher.

Current Status of Electric Booster Melting 635
A brief review applicability, uses and the economics of electric booster melting. By L. Penberthy.

Materials and Manufacture Discussed at West Coast Meeting 636
Large attendance marks the Eighth West Coast Regional Meeting of the American Ceramic Society.

Some Practical Aspects of Seeds and Fining 637
A summary of a paper delivered at the Fifteenth Conference on Glass Problems held at Ohio State University. By J. W. Wright.

Inventors and Inventions 638
A summary of recently issued patents of interest to the glass industry.

Research Digest 643
A new system of sectionalized and controlled convection heating in a lehr is outlined in this review.

Current Statistical Position of Glass 646
Production, shipments and employment in the glass industry during September and October, 1955.

New Equipment and Supplies... 642

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125,143 TONS IN 1074 DAYS!

WE feel sure the information given at right will interest you. It's the operating data on another tank where Corhart Zac Electrocast blocks did an excellent job.

QUALITY ECONOMY ENDURANCE

CORHART ELECTROCAST REFRACTORIES

GLASS	Type	Soda-lime
SIZE	Melting area (square feet)	1011
	Melting end depth (inches)	42
LIFE	Total production days	678.9
	Total days under fire	1,074.0
PULL	Total fill (tons)	129,442
	Total glass pulled (tons)	125,143
	Total production pulled (tons)	112,418
	Pull per production day (average, tons)	165
	Square feet of melting area per ton glass per operating day	6.13
FUEL	Type	Natural gas
	Heat value per cubic foot (B.T.U.'s) estimated	1,020
	Total tank gas (cubic feet)	1,341,181 M
	Total production gas	1,001,394 M
	Gas per production day (average, cubic feet)	1,475 M
	Percent cullet charged (average)	65

TON=2000 pounds M=1000 cubic feet

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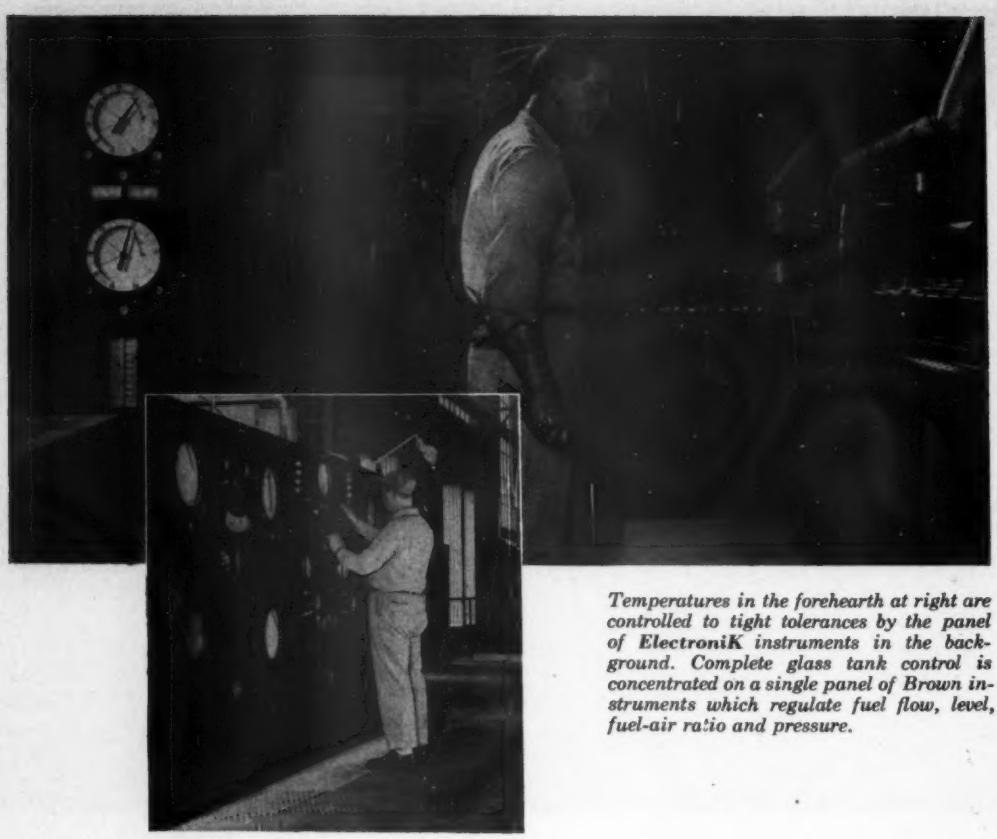

Temperatures in the forehearth at right are controlled to tight tolerances by the panel of ElectroniK instruments in the background. Complete glass tank control is concentrated on a single panel of Brown instruments which regulate fuel flow, level, fuel-air ratio and pressure.

Bottle output up, quality boosted *by forehearth and tank controls using ElectroniK instruments*

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● **REFERENCE DATA:**
Write for Data Sheet No. 1.4-1a, "Forehearth Temperature Controls", and for a copy of *Instrumentation*, Vol. 7, No. 6.

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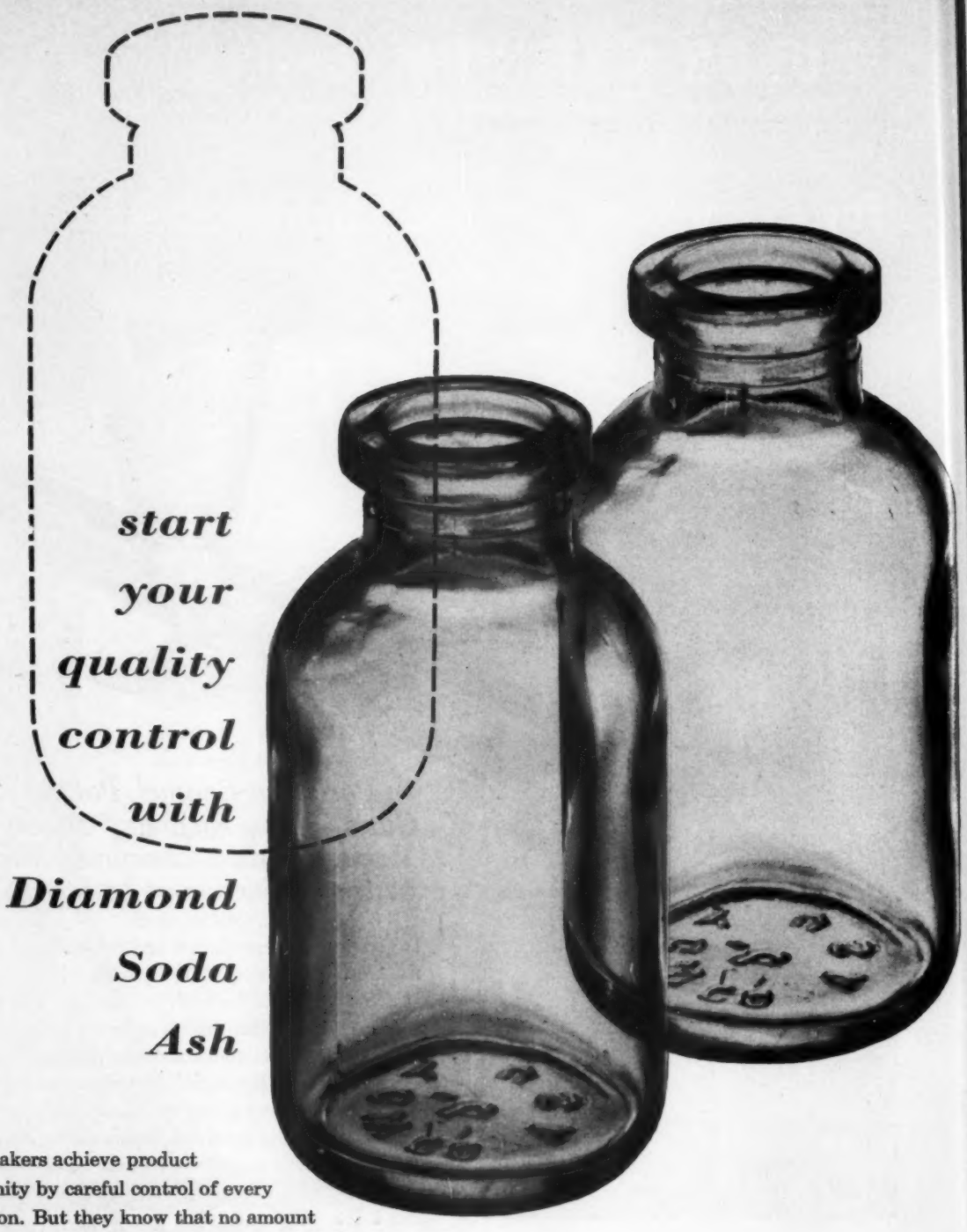

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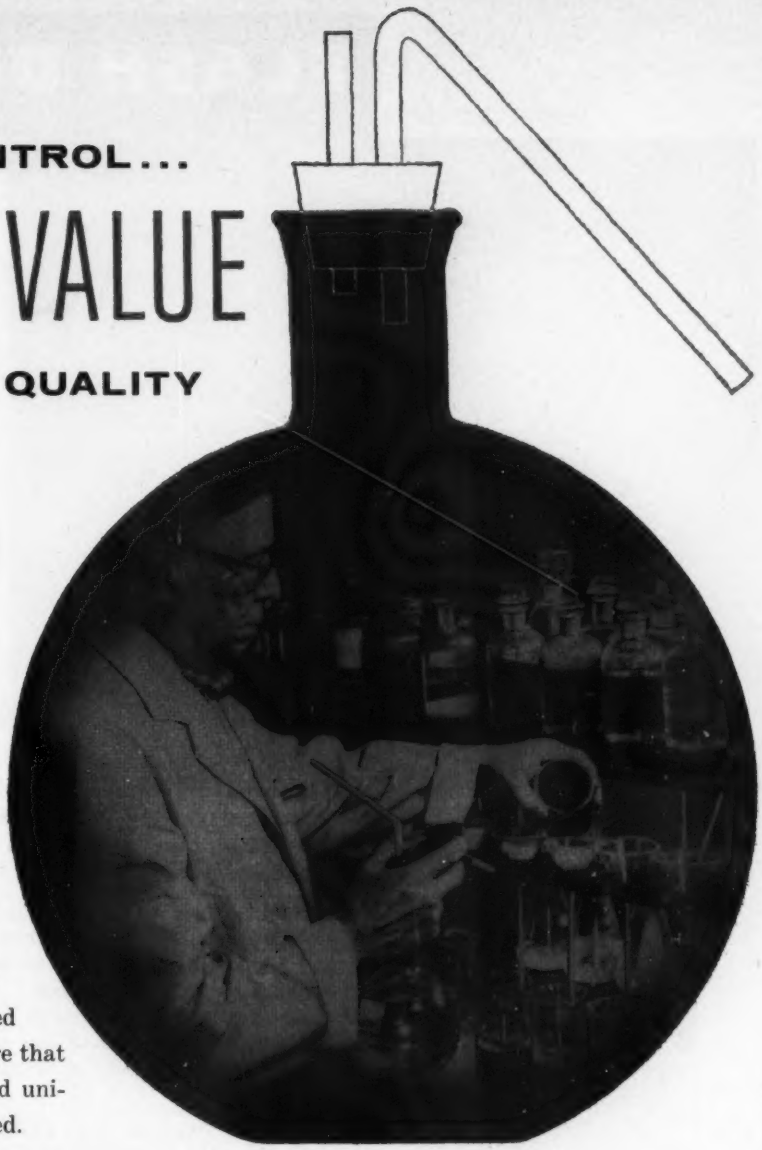

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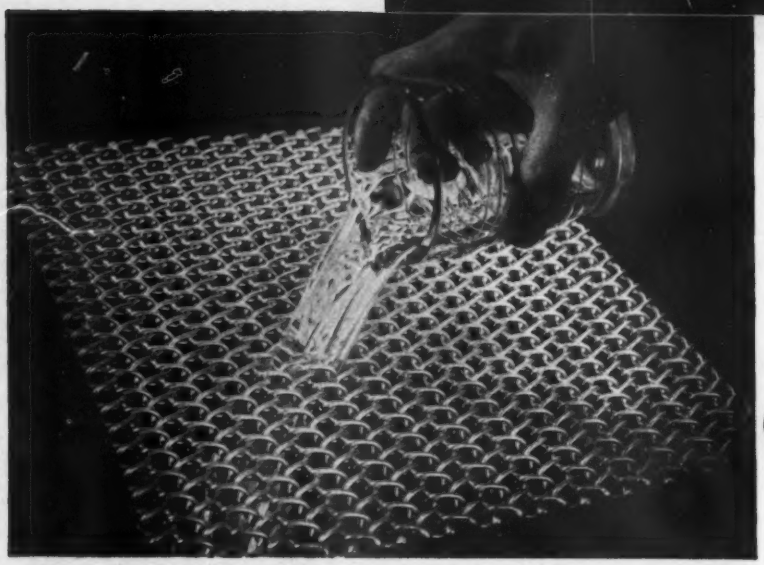

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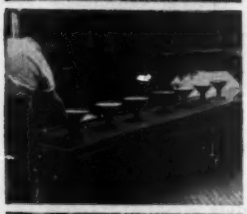

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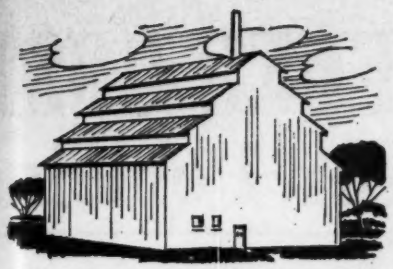

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Linde silicones brighten the glass picture

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$82,000 SAVED IN FUEL COST
using Kaiser Periclase

The following information is taken from a paper presented at the Refractories Session of the 56th Annual Meeting—American Ceramic Society, April 19-23, 1954. Paper prepared by John B. Minshall and James C. Hicks, Kaiser Aluminum & Chemical Corporation, Oakland, California.

The report compares the performance records of three types of basic brick during three separate campaigns in the regenerators of the same container glass furnace during the period June 30, 1947 through January 28, 1954.

During the course of this six and one-half year study, three different types of basic refractory brick were used. In the first campaign, lasting from June 30, 1947 through December 31, 1948 (18 months), the refractory used for the top courses was a fired brick comprised of a bonded aggregate of *natural olivine grains.*

Through the second campaign which lasted from January 22, 1949 to January 31, 1951 (24 months and nine days), the top checker courses were composed of Kaiser Periclase A refractory brick which are *91 per cent magnesia grain* bonded by finely divided high purity magnesia and silica. This composition reacts to form a crystalline magnesium ortho-silicate bond under the temperature of the glass regenerators. The high purity magnesium ortho-silicate bond, resulting from the solid phase reaction of the fine magnesia and silica, gives these refractories great volume stability and resistance to attack by the fluxing materials carried over in the flue gases of glass furnaces.

The fine silica used in the bond of these refractories lubricates the batch so that the pressed shapes have an unusually low fired A.S.T.M. porosity of from sixteen (16) to eighteen (18) per cent. The composition of the Kaiser Periclase A Brick is approximately *87 per MgO.*

Three-year campaign

During the third campaign from February 24, 1951 through January 28, 1954 (35 months and three days) in addition to the Kaiser Periclase A Brick, Kaiser Periclase D Checker Brick—one of the most advanced basic refractory products developed in recent years—was used in the top courses of the checkers.

The composition developed for this purpose results in a brick—Kaiser Periclase D Checker Brick—containing over 95 per cent magnesium oxide, and having high density and thermal efficiency. The high density and absence of impurities provided the properties needed for superior resistance to batch carryover. Installed in chemically bonded form, Kaiser Periclase D Brick becomes ceramically bonded with a tight network of pure periclase crystals while the furnace is being raised to operating temperature.

Furnace description

The three campaigns were conducted in a continuous bottle tank furnace melting soda lime glass.

In the first campaign which started in June 1947, the checkers had been set with eight courses of the olivine type refractory under the Number 1 and 2 port areas. The balance of the upper 16 courses of checker brick were super-duty fireclay. The lower portion of the setting down to the rider arches consisted of first quality fireclay. All brick in this setting were 9" x 4½" x 2½" set in the conventional open arrangement.

For a considerable length of time before the end of this first campaign it had become necessary to use forced draft and boosters on the burners in order to maintain proper combustion. The olivine brick had started to break up and erode as early as nine months after the installation was made. At the end of this 18-month campaign, the setting of the first basic brick was badly disrupted. The brick had swelled to such an extent that the bulkheads at the feed end had been pushed out. Some of the upper courses of these brick had broken up, fallen into the flues and clogged them.

Destruction of super-duty fireclay

The super-duty fireclay opposite Number 3 and 4 ports exhibited the destruction typical of this composition. The topmost course had disappeared and much of remaining courses had been washed down, in some cases, to less than 20 per cent of their original thickness. Lower in the setting both super-duty and first quality fire brick exhibited bloating and excessive accumulation of carry-over. The poor condition of the checkers was a contributing factor for terminating this campaign.

In view of the findings of this first campaign, management of this plant decided to use the Kaiser Periclase A Brick in the second campaign and to extend the depth of this basic portion. The regenerators were rebuilt in January 1949 with 12 courses of the Kaiser Periclase A Brick below Number 1 and 2 port areas. The courses of basic brick consisted of 12" x 4½" x 2½" shapes set in an open basketweave. Four courses of super-duty fire brick were below these, and the rest of the 44 course setting was first quality fire brick. Super-duty were also used in the first 16 courses under Number 3 and 4 ports. All of the clay brick in the setting were 9" x 4½" x 2½" straights laid in the conventional manner.

When the furnace was re-built for this campaign a small quantity of the 95 per cent MgO Kaiser Periclase D Brick was also installed on the top course under Number 1 port in the south regenerator as a test.

During the first three to six months of the second campaign no appreciable changes were noted in the top courses of the periclase brick opposite the Number 1 ports. Minor expansion and checking was noticeable, but the brick retained their sharp edges and corners.

At the end of nine months the top course of brick exhibited some checking. Some of the brick had expanded and curled so that the checker setting appeared to be out of line, but from this time through the rest of the 24-month and nine-day campaign the Kaiser Periclase A Brick appeared to remain in a relatively fixed state. Although the top course showed some additional checking and cracks opening to wider angles, the edges of the brick remained quite sharp.

Increased application of basic brick

In the ensuing campaign it was decided to take advantage of another type of tank block which has been proved to give superior service. Then it became necessary to plan for longer regenerator life. This problem was approached from two directions: first, the application of a basic refractory superior to those previously employed and secondly the more extensive use of basic brick.

Increased application of periclase bricks had two aspects. Clogging of the clay brick under the basic brick during the second campaign indicated the need for going deeper with the periclase under Number 1 and Number 2 ports. This section was extended down 17 courses instead of the previous 12. It was believed that due to their high thermal efficiency the additional periclase brick would then cool the gases and batch carryover to the point where they would not react

VER THREE-YEAR CAMPAIGN
hecker Brick

with the clay brick. In addition periclase brick were extended past Number 3 port so that the overall length of the basic setting was 25 feet 2 inches as compared with 18 feet in the previous campaign. This horizontal extension of periclase brick consisted of the five top courses. The purpose of this latter change was to avoid the expected complete failure of the super-duty fireclay in that section during an extended campaign.

Extended use of Periclase D

With regard to the use of a superior refractory it will be recalled that a few Kaiser Periclase D Checker Bricks were installed in the previous setting. Indications from this test were excellent; so it was decided to give them a full scale application. This brick was used for the top two (2) courses of the entire basic setting. The balance of this installation beneath the Periclase A Brick consisted of first quality fireclay topped by one course of super-duty. In order to avoid the accumulation of drip from the fireclay brick in the main port crowns and sidewalls, all of these areas, except those adjacent to the Number 4 ports, were re-built using basic brick. As before, all periclase brick were set in open basket-weave, and all clay brick were conventionally laid.

The third campaign began February 24, 1951 and continued for 35 months and three days. When the furnace was torn down for non-operational reasons of management, it was the unanimous opinion of those present during the tear down, that the basic refractories in the regenerator chambers would have given an additional 12 months, and possibly 18 months, economical service—four to four-and-a-half years total.

Flues stay open

As forecast by the second campaign, the Kaiser Periclase A Brick were extremely clean, and they had allowed the flues to remain completely open. Laboratory tests had shown that these brick from the third course on down had retained the same high hot load strength they had when they were new, i.e., the used Kaiser Periclase A Brick would stand under hot load of 25 pounds per square inch at 2900° to 3100° F.

The two top courses of the Kaiser Periclase D Brick were in considerably better condition at the end of thirty-five months than were the Kaiser Periclase A Brick in the same location at the end of the previous campaign of twenty-four months.

An interesting comparison between fireclay and periclase brick in this furnace was demonstrated by the conditions under Number 3 and Number 4 ports. The fireclay under Number 4 while still in fair condition showed considerable accumulations. In contrast, periclase brick under Number 3 port were still clean and sharp while the fireclay, which started at the fifth course in this area, also showed build-up. This comparison was found to apply generally as the tear-down progressed.

Summary of figures for the three campaigns

	1948	1951	1954
LIFE			
Operating days	521	720	1,038
PULL			
Total tons of glass melted	*	70,438	109,423
Average tons of glass per operating day	*	97.8	105.4
Total tons of glass per square foot of melting area during campaign	*	100.6	156.3
Square feet of melting area per ton per day	*	7.16	6.64

Asterisks indicate figures are not available. It should be noted that the three year campaign represents the higher rate of production rather than the lower as might be assumed by service results previously described.

Fuel consumption of three campaigns

A comparison of the relative fuel consumption of these three campaigns is of considerable interest. It should be borne in mind that during this period there were improvements in the operating technique—specifically more accurate control of batch feed and furnace temperature. The average fuel consumption for the first campaign is not available. The second campaign averaged 10,967 cubic feet per ton of glass produced. The fuel consumption increased from 9,342 cu. ft. near the beginning of the second campaign to a high of 11,600 in the latter part. These figures were taken from months having the same average glass production rates.

Since there was an appreciable quantity of periclase brick in the checkers during the third campaign it was decided to attempt to take greater advantage of their high thermal efficiency by shortening the regenerative cycle. Early in the third campaign reversal was reduced from 20 minutes to 15 minutes, and it was believed the change contributed to the increased efficiency of the furnace.

Consideration must be given to this change as well as the previously mentioned improved tank blocks; also to the more rigid control of batch feed and furnace temperatures. However, the major credit appears to definitely relate to the improved checker packing.

During the nearly three years of the third campaign—with extensive use of Kaiser Periclase D Brick—the gas consumption remained an almost constant figure of 8662 cubic feet per ton of glass produced. In this campaign this plant saved 2305 cubic feet of gas per ton of glass produced as compared to the second campaign. At current rates in the area where this plant is located, this resulted in a saving of more than 74.9 cents per ton of glass, or a total saving of $82,000.00 on fuel over the three year campaign.

For supporting data on how the superior characteristics of Kaiser Periclase Brick can increase the service life of your checkers, see our booklet, "A Report on a Better Basic Brick for the Glass Industry." If you don't have this valuable booklet, write for your free copy to:

Kaiser Chemicals Division, *Kaiser Aluminum & Chemical Sales, Inc. Regional Sales Offices: 1924 Broadway,* OAKLAND *12, California . . . 3 Gateway Center,* PITTSBURGH, *Pennsylvania . . . 518 Calumet Building, 5231 Hohman Avenue, Hammond, Indiana* (CHICAGO).

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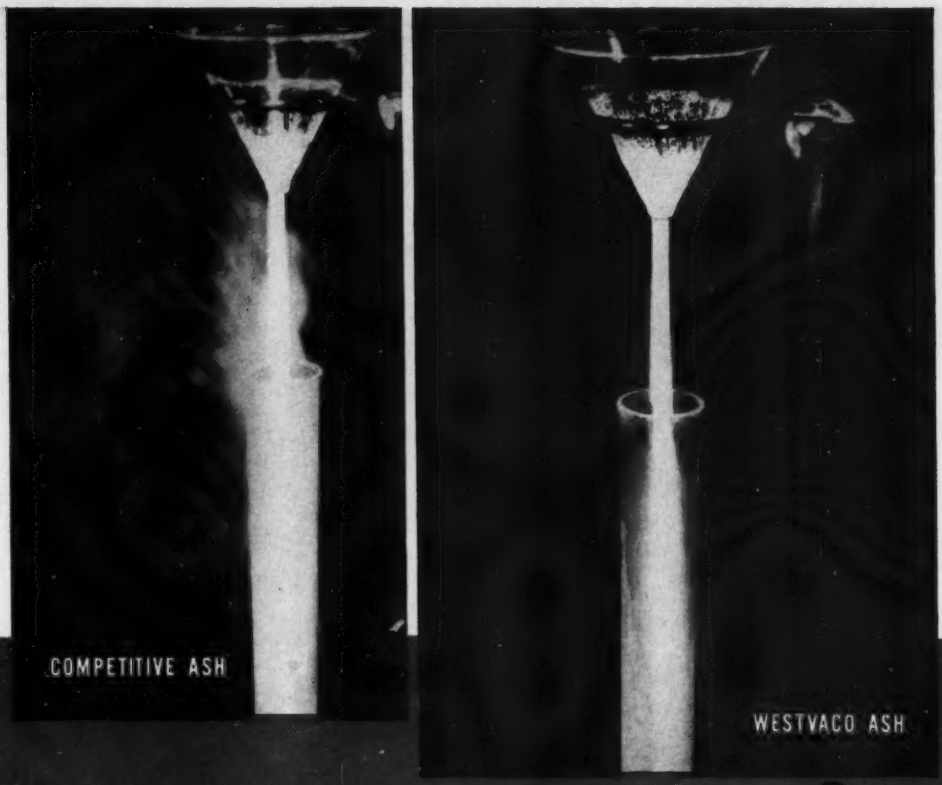

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the glass industry
VOLUME 36, NUMBER 12, DECEMBER, 1955

"Technically Speaking"

about the new Owens-Illinois Technical Center

by H. H. Holscher*

Foreword:

The author wishes to thank his colleagues at Owens-Illinois for permission to use material never before published.

● SOME WEEKS AGO the Technical Center was dedicated and you may have seen stories describing this event in the business press.

To many of us, the Technical Center is a dream come true. It represents long days and weeks—yes, even years of planning, in which flexibility of the building received continuous attention. The Technical Center is most of all a home for the research, development and engineering activities of Owens-Illinois. It brings together for the first time its scientific personnel which were formerly widely located. There are of course additional scientific personnel in Owens-Illinois. We have laboratories at most plants. In addition, there are quality evaluation laboratories, groups for customer processing problems and other engineering groups that work on problems limited to a single plant or area. However, the Technical Center serves as the heart of the O-I scientific personnel. The heart-beat is the important thing, however, and the building is thus incidental to the processes going on inside. The attention that was paid to factors such as space, design, convenience and daylighting in the new Technical Center help inspire the excellent morale of its staff. We will briefly discuss the facility and then highlight some of the operations going on in it.

Three Types of Facilities

There are three major types of facilities. The front area, comprising two 60 feet wide areas each 260 feet long, together with two 60 x 80 feet connecting wings—all with basement and second story—is a laboratory, office, designing and drafting area. In this area the facilities make complete interchangeability possible. Any area may be used for any of the above types of work. The floor, partitioning, systems, etc., are all built on a modular layout which can be arranged into units of any desired size from a one-man private laboratory, with complete facilities, to a multiple unit laboratory, Fig. 1, for a large group of men. Areas can be made the full building width without hallway, for such activities as design and engineering, Fig. 4. The color schemes are varied enough to be interesting.

The second major type of area is the high-bay pilot plant. No other facility in the world for research and development in glass approaches it. The high-bay pilot plant functions as an experimental glass plant. It occupies an area about 160 x 160 feet, of which about 4,000 square feet serves as a batch storage and batch handling plant. Roughly, 9,000 square feet serves as an area for small scale melting, along with other furnace operations requiring a high roof clearance. Incidentally, the clearance to the bottom of the roof truss in this entire 160 x 160 area is 27 feet. The clearance to the roof deck is 35 feet. Good glasshouse type ventilators are used. In the area for the furnaces we have a 10 foot deep pit, 25 x 120 feet, in the floor for furnace and regenerator height. There is an additional basement area 35 x 120 feet for cullet handling.

In the high-bay area of the pilot plant, space has been provided for three end-port type regenerative furnaces to provide glass for glass-forming studies and development. Two of these, each capable of providing 25 to 30 tons of glass per day, have been built. The third, similar to the larger of the present furnaces, will be built when needed. Five forehearths, each with a gob feeder mechanism, are provided on the existing furnaces. The pilot

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Fig. 1. A section of the Glass Properties Laboratory. This is typical of the fifty laboratories in the building and is an illustration of a large area accommodating several workers.

plant facilities for melting this tonnage of glass per day allow a complete operation.

We have mentioned that there are at least five feeders operating, Fig. 2. Each position has a different type of machine, each of which is experimental from some particular viewpoint. The machines are experimental units or adaptations of commercial units. Each represents a specific development. A list of such units would serve no useful purpose because it changes from month to month. Here operates a group of projects of interest to different divisions of the company. All engineering divisions have assignments and access to the hot glass and can carry on their experimentation here without interfering in or being interfered with by day-to-day production problems.

The third major type of area is the pilot area with 14 feet clearance sawtooth roof type construction, Fig. 3. Here are areas for annealing and heat treating, decoration and coating, inspection and electronics, raw material processing, chemical engineering, TV processing, post forming, etc., and in fact any type of processing which is too big for the laboratory areas, but still not of a forming nature.

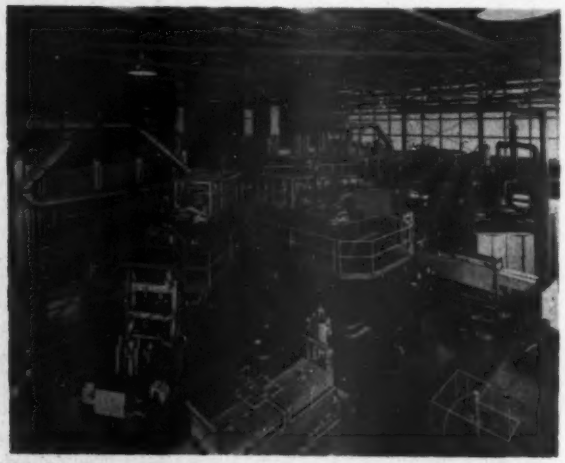


Fig. 2. The pilot plant of the new Owens-Illinois Techical Center, viewed from above, is a maze of experimental equipment. It represents the final stage in the complete cycle of research at the new Center. This battery of experimental forming machines, fed by two 25-ton furnaces, is capable of producing 75 tons of experimental glass products daily.

In short, then, here is a Technical Center built for complete freedom of operation from a melt of .1 gram to 100 tons of glass per day, for an experiment on a .01 inch chip of glass to one on an article weighing many pounds, for equipment from the analysis of glass for .0001 per cent chromium to a final production machine 16 feet in diameter. Note that this is not alone a research center, nor a development center, nor a design center, nor an engineering center, but a Technical Center which covers all these activities in an inclusive fashion.

Types of Personnel

The Technical Center houses more than 500 people including all types of service people as well as technical personnel. A listing of the various types of trained personnel concentrated here would include, I am sure, every

Fig. 3. Illustrating the pilot plant area with clearance of approximately 14 feet, showing a lehr installed for several pilot operations. Beyond, one can see several other experimental pilot plant areas.

major technological branch of American industry. While Owens-Illinois' primary product is glass, the interests of the company are diversified enough to require that all sorts of talent be available. In fact, diversification is an expected product of the Technical Center.

We are going to tell you something about this facility from a technical viewpoint. This is because the life that is lived in the Center is primarily a technical one. It is a carefully organized, painstaking and thorough life going on in the midst of an ideal atmosphere conducive to usage of not only the physical facilities, but more important, the intellectual powers available. If a man knows that another in the building may contribute to his own progress or problem, it is only a matter of a few minutes until the two can be together in conference. Under these circumstances, failure to combine ideas and thoughts can hardly go unnoticed.

It is, of course, impossible to describe the complete activities in the Technical Center. To do so would result in a book which I am sure many people would find of value. But the book would no more be written than it would be out-of-date. No one individual could write such

a story because the mere gathering of data which could be used would require such time that some of it would be out-of-date. There are a few things which could be classified among the facilities which we could call standard, or "old hat." We will try to emphasize some of the new.

Organization

The more than 500 people referred to are employees of four divisions or subsidiaries of the company. These are the Administrative, Glass Container, and Libbey Divisions and the Kimble Glass Company, a subsidiary. O. G. Burch, vice president, Engineering and Research, has line responsibility for all research, development and engineering work carried on by the Administrative Division and staff responsibility for co-ordination of all such work done by the divisions and subsidiaries. This latter responsibility of co-ordination of divisional engineering and development work is delegated largely to the Administrative Engineering Department, headed by J. D. Northup, director of engineering. The Administrative Engineering Department also has line responsibility for those phases of engineering having to do with facility design and construction, systems installations and major changes thereto and furnace design for all glass making divisions of the company. On occasion, they undertake process development work concerned with improvement of present processes, particularly when such work is thought to benefit more than one of the operating divisions.

A second Administrative Division group in the Technical Center is the Services Group headed by E. H. Dwyer, business manager. This group includes the batch and furnace personnel, the machine shop staff, purchasing and stores, the library, photographic and blue print, personnel, accounting, and facilities maintenance.

The machine and maintenance shops, together, occupy an area approximately 80 x 180 feet, not including the stores. These shops are equipped with an enviable array of machine tools. The equipment is such that most of the required work can be done within the Technical Center. Only an occasional part requires facilities not available in the shop. Much ingenuity is shown in the use of the machine shop by a crew of approximately thirty.

One of the most important central functions is the library, Fig. 5. Here we have available a collection of books, reports and trade literature on all fields of interest to the various technical people in the building. If a publication is not available here, it can readily be obtained upon request, either permanently or on a loan basis, through inter-library loan privileges covering research and thesis work all over the country. The present library collection totals nearly 6,000 volumes. There are 50 file drawers of internal reports, 10 drawers of catalogs, 10 drawers of government documents, 15 drawers in the information file and 9 drawers of miscellaneous material. We get approximately 250 periodicals of all types.

The third Administrative Division group is the General Research Department. This is headed by J. W. Hackett, director of research. This group does research and development work for the whole company and its subsidiaries. Some work is done at the request of and expense of the division or subsidiary whose interest is paramount. If all divisions and subsidiaries have interest, then the Administrative Division requests the work. The activities of this department will be covered in more detail later in this paper.

The remaining three groups within the Technical Center are the Engineering Departments of the Glass Container Division, Libbey Division and the Kimble Glass Company. Glass Container Engineering operates for the Glass Container Division on all types of engineering, development, materials, etc., under J. E. McBurney, chief engineer. In a similar fashion, we have Libbey Engineering under C. W. McCreery, chief engineer and Kimble Engineering under F. D. Pinotti, chief engineer. In each case, these chief engineers report to the operating managers of their respective divisions or subsidiaries in the general offices of the company. Major divisions in each of the groups may include design, raw materials, specification and control, inspection, instrumentation, development work of a control nature, materials developments and general development work of specific and opportune nature.

Furthermore, the divisional and subsidiary engineering groups have responsibility for improvement and refinement of present processes and products. Much work has been done on completely automatic inspection devices, handling improvements and other items conducive to low cost production. Operational details of the batch and furnace department, control of melting, control of color and composition, paper and paper-board processes, annealing or heat treating, etc., are handled. In one case there is co-ordination of the plant laboratories with testing and adoption of new auxiliary production materials and processes to improve present operation and life. Trouble-shooting all along the line is an important function. In addition, the divisional and subsidiary engineering groups handle certain developments for which they are particularly equipped, both man-wise and machine-wise. Refinement of process and complete commercialization of new machines and new processes is likely to rest with the operating engineering divisions.

The remainder of this article will describe the activities and functions of the General Research Department.

Service Laboratories

There are two laboratories which should be considered as service functions for all technical groups. These comprise the Analytical Laboratory and the Glass Properties Laboratory.

Upon request, the Analytical Laboratory will perform whatever analytical procedures one wishes. It does continual work on improvement in procedures for analysis.

Space over-all is 106 x 24 feet and is divided into five areas, Fig. 6, a sample preparation and general storage area and four connecting analytical areas (20′ x 20′). Approximately 20 feet of bench space and 10 feet of hood space is provided for each analyst. Hoods are specially designed for use of perchloric acid and installation in an air-conditioned building. They are built of Alberene soapstone, Fig. 7, and have spray pipes and nozzles behind the baffles and in the exhaust duct system. Duct and grill work supply unconditioned outside air to the hood lintels in an amount equal to 65 per cent of the total exhaust. Only 35 per cent of exhaust is room

air. Equipment and techniques used include two flame spectrophotometers and Beckman DU spectrophotometer and four electrophotometers for general colorimetry. Electrolytical apparatus, a polarograph and potentiometric titration apparatus are used. Also featured are three single pan Mettler balances for rapid weighing in gravimetric work. Eight analysts are employed plus supervisor and technician who prepares samples, runs screen tests and maintains the storage area.

The Glass Properties Laboratory has extensive equipment for some twenty types of measurements. We have here two types of high temperature viscosity measurements. One is the falling ball and the other is the concentric cylinder type. The viscosity curve is completed with the fiber softening point and the low temperature weighted-fiber determinations made under constant temperature conditions. The annealing characteristics are interpreted from these curves as well as being measured under actual stress conditions. Young's Modulus can be measured from room temperature up into the annealing zone. There are several liquidus furnaces, as well as all sorts of color measurements covering the ultra-violet into the near infra-red. There are standard illuminating set-ups for visual study of color. Thermal expansion and contraction is measured by either of two methods—the quartz dilatometer and the interferometer. Direct measurement of sealing characteristics and stresses is made by the use of butt and other type seals. Measurements

Fig. 4. Extensive design work on all kinds of machinery, plants, furnaces, etc., occupies a large proportion of the front wing. Shown is a typical drafting and design area with design office and conference room in the distance.

Fig. 5. The library serves the entire Technical Center personnel. It has 6,000 books and about 250 different periodicals; a center of activity when a new research project is planned.

Fig. 6. The analytical area, partly shown here, does service work for all divisions. This layout was designed to provide individual unit areas yet still connect them for ease of communication and to convey the feeling of openness.

of many other properties such as density, index of refraction are, of course, commonplace. In addition, all electrical properties of glass can be determined in this laboratory. Once again, this is a service for the entire Technical Center—available upon request.

Materials Research

The General Research Department offers perhaps the most interest as far as new things are concerned. We find here a lot of the "old hat" commonly accepted functions, which are indispensable to research in general, as well as those things which are exploratory and "blue-sky." As is to be expected the laboratory is divided into several of the normal types of laboratories. We have the Physics, Physical Chemistry, Solid State, Glass Technology, Chemistry, Ceramics and Plastics laboratories. Mostly these fall into a grouping known as Materials Research. Then there are the very extensive Product Research and Process groups. Specific breakdowns are too complex, but this serves to orient one as to the laboratory, semi-pilot and pilot scale research and development. Certain phases of research and development will naturally fall to the various engineering groups when they are closely related to an operating setup.

Our purpose here is to point up the unusual and leave the "old hat" lie. We begin with the Physical Chemistry and Solid State Research.

For instance, for many years we have been working on the structure of glass both by work in our laboratory and by sponsored work in outside laboratories. This work is growing and the hope is to determine the basic structure of glass. This we define as position, form and motion, of the atomic building blocks. Much of this work is at universities or other outside laboratories because we feel that wider freedom of action and thought is thus secured. Studies on the short range order structure include infrared absorption and Raman spectrum determinations of irradiated and non-irradiated quartz, cristobalite, and vitreous silica. Low temperature specific heat measurements supplement these studies. Disorder of long ranges is being studied with the electron microscope. Also, we have used studies of X-ray at low temperature, neutron diffraction, effects of high pressures, etc. Structural interpretations of present data are constantly made and revised. Needless to say, the revision seems continuous but we know this to be progress. We believe Owens-Illinois is a leader in this fundamental work.

Fig. 8. The Vickers Projection Microscope, shown here, can be especially adapted to interference work by use of the special cell shown on the table underneath the large round dial. Magnification of vertical contours can be made at about 100,000 times.

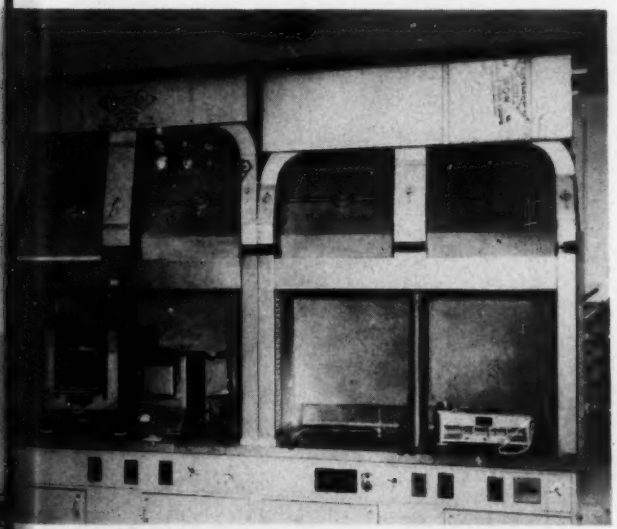


Fig. 7. Details of Analytical Laboratory hoods which were specially designed for an air conditioned building. Note the duct work around the top and two sides of the work opening. These supply unconditioned air, thus reducing the loss of cooled room air about 60 to 70 per cent.

Most scientists have a conception of interferometric techniques. The principle is one of superposition of two or more light beams which results in a change in light intensity. Complete interference results in no light, while various shades of intensity result from different degrees of interference. Practically, one sees alternate bands, lines, or fringes which on displacement measure the interference in terms of the wave length being used. Parallel and linear bands indicate a condition approaching optical flatness. Curved bands indicate degrees of departure from optical flatness. Contour patterns are formed looking something like contour maps of the earth's surface. At the new Technical Center we have a Vickers Multiple Beam Interference Microscope, Fig. 8, which uses multiple light beams plus magnification sufficient to estimate contour deviations of about 25 Angstrom units. This is usable directly on relatively flat surfaces for measuring contour variations. Approaching the problem from another direction, if we have an optically flat surface to

begin with, we can compare differences of index of refraction of the specimen to a very fine degree if we immerse the sample in a liquid of specific index of refraction. The build-up of interference then measures changes of composition, for instance the study of cords or inhomogeneities in glass. A plot of index change gives direct correlation to composition change if the effects of composition on index of refraction are known.

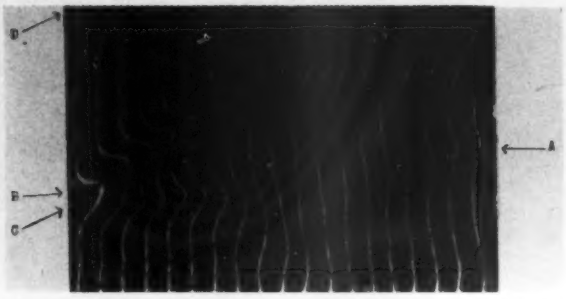


Fig. 9. Certain deviations from flatness are shown in the contour photograph taken on the interference microscope. At "B", for instance, we have a valley of about 3900 A° depth running from the edge to the upper right hand corner. Other marked areas are discussed in the text. (Unpublished work of J. Francl and J. S. Logiudice.)

We have illustrated a contour map of a glass surface, Fig. 9. This photograph shows a fringe pattern of a glass surface showing imperfections in the surface. On the right center (A) is a small irregularity of about 210 Angstrom units. On the left center (B) is a valley of about 3860 Å extending to the upper right-hand corner of the photograph. Just below this (C) is another shorter and less deep valley (2460 Å). At the upper edge of the glass (D) we see a non-uniform hill of from 1350 Å in dimension, up to 2500 Å or more. Magnification of depth is about 200,000 times.

Other Physical Chemistry work includes phase identification, internal friction, differential thermal analysis, etc.

In the Physics and Metals group we have first of all an instrumentation group. Here are experts in temperature measurements and electronics. In addition, we have the X-ray, which is useful for phase identification. Extensive study of materials by this procedure is a common technique. The equipment includes two electric recording instruments. The Metals research covers extensive work on high temperature metals, metal coatings, etc. This work is in close cooperation with the forming work where we shape glass against metals. A complete Metals melting pilot plant is also available.

In order to learn more about the strength and elasticity of glass at high temperatures where it is also capable of easy deformation, we have developed a special tensile testing machine which is able to test a heated rod sample to failure in as little as .001 second. Load is applied by an air cylinder, Fig. 10, and both its magnitude and rate of application can be varied. The force developed across the sample is sensed by a strain gauge type load cell capable of handling forces up to 4,000 pounds. The deformation is determined by the opposing action of two differential transformers connected to the ends of the specimen. Both force and deformation are simultaneously indicated on a double-beam cathode-ray oscilloscope and recorded by photography. A photograph of the oscilloscope indication, Fig. 11, is also shown. Here a modulus of elasticity at 1250° F. under a time factor of .001 second can be determined. The diagram is adequately marked with time, load and extension of the glass.

Other major equipment in Physics includes a very precise electronic recording of internal friction (a mechanical property) at considerably below room temperature up to the deformation of the glass. Sound-measuring equipment is available. We can record, analyze and study sounds and noises. Measurements are made on an over-all basis and within specific octave bands of frequency. Noises accompanying the movements of air, from blowers to cooling nozzles, are of interest.

The Chemistry group works on many and varied projects. First there is a group working on chemical durability of glass. Then there are general and specific plastics problems including all types of such materials in widely divergent uses. This covers materials for plastic containers, including bottles, coating agents for other materials, notably glass, as well as adhesives. There is continuous study of bottle coatings to prevent damage. This work started many years ago and resulted in the presently used commercial process. Plastic materials are studied as ingredients for decoration or coating. Adhesion of organic materials to glass is an important phase now being studied by use of radioactive tracer technique. In this process a radioactive tracer can be inserted in the organic material and the amount remaining in the sample after any period of testing can be accurately determined.

Fig. 10. Equipment for determining the high temperature strength and elasticity of glass. The rod is shown mounted ready for test. The two furnaces shown open (with transite covers) close around the glass specimen. The cylinder at bottom applies the load.

Owens-Illinois has been active for many years in the hydrous calcium silicate field. A fundamental study initiated more than a decade ago has been concerned with the phases present in the system $CaO \cdot SiO_2 \cdot H_2O$ under varying conditions. This structure work has been advanced by X-ray, differential thermal analysis, shrinkage and other procedures. A hydrous calcium silicate having the composition $4CaO \cdot 5SiO_2 \cdot 5H_2O$ plus some gels has been widely used as thermal insulation to temperatures of around 1200° F. A similar material with lower water content shows possibilities of being usable to temperatures up to 2000° F.

The Glass Technology Section has primary responsibilities for studies of glass properties versus composition. All glasses are melted in platinum and analyzed before they are acceptable for property measurements. This work has been going on for about twenty years and many systems of composition have been studied. The section also acts as advisor for all engineering departments on such properties.

In addition, the Glass Technology Section has a group of major research problems. These include such things as development of special glass compositions, effects of a number of variables upon color variations in glass, annealing and stress studies, temperatures of glass and molds under simulative service conditions, etc.

An important recent contribution was the development of a solder glass for use in color television programs. We believe that this method of low temperature glass-to-glass sealing has many applications.

Typical work by Glass Technology on the experimental press, which is described later, yields the result shown in the graph presented, Fig. 12. Here are temperatures of an experimental blank mold operating at a rate of 4.6 per minute, in a study of heat transfer from the glass to the mold. Thermocouple depths indicated on the figure are the distances from the glass-metal interface to the several thermocouple positions. The gob is loaded in the blank about 0.1 sec. before the No. 1 thermocouple starts its cyclic rise. Note the decrease in temperature level and wave amplitude, and the lag of the temperature wave, as the distance from the interface increases.

As an illustration of work on stress release we show another graph, Fig. 13. This chart gives data on release of mechanically applied stress from an experimental potash-soda-lime glass at 840°F. A lath sample is brought to the required temperature and then strained in flexure to produce an initial birefringence equivalent to a stress of approximately 1600 psi. Birefringence is recorded as a function of time while the stress decays in the sample. From previously determined data on the

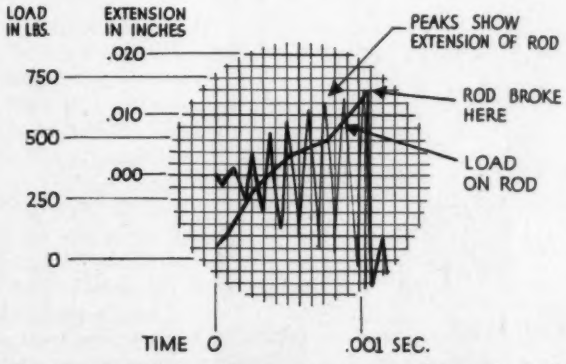


Fig. 11. A typical oscilloscope trace secured from the high temperature strength and elasticity setup. The load build-up, the extension of the glass and the breaking are all shown against time. (Unpublished data of T. C. Baker.)

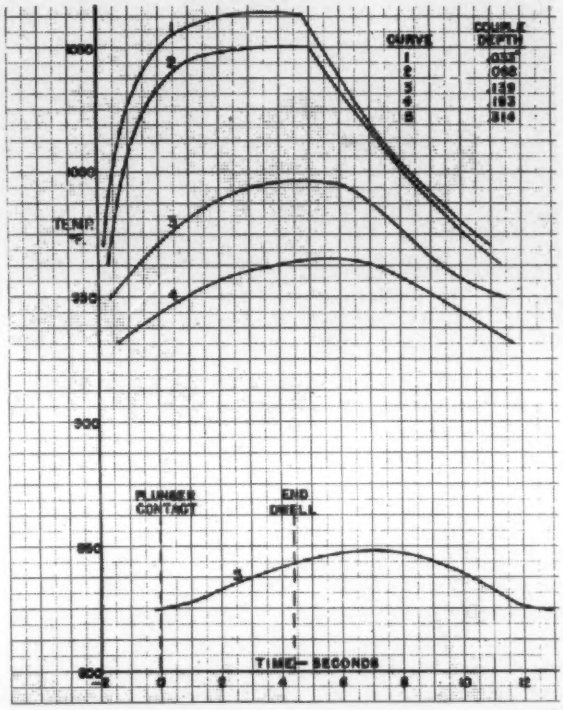


Fig. 12. The temperatures of a blank mold at various depths and times in the Cycle are illustrated here. Note the cyclical effect, particularly the trends in time apparent at different depths in the metal. (Unpublished data of D. A. McGraw and C. L. Babcock.)

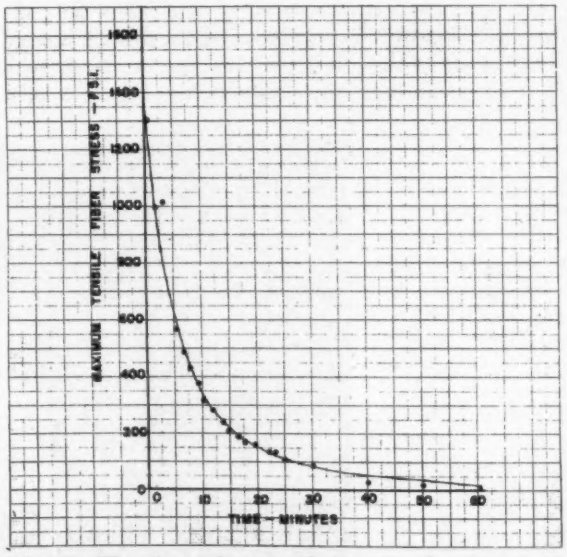


Fig. 13. The release of stress with time, at a glass temperature of 840°F. is shown here for an experimental composition. This is part of an over-all program on properties of glass at intermediate temperatures. (Unpublished data of G. C. Godejahn and A. F. Van Zee.)

Fig. 14. The small regenerative test furnace for refractory testing. Note the regenerator, the burners and the duct work and blower.

stress-optical coefficient of the glass at elevated temperatures, the birefringence values are converted to stresses in pounds per square inch. This work is part of a study of the effects of viscous and elastic properties on annealing of glass.

The Ceramics Section concerns itself with raw materials and refractories. Since freight charges are very important, raw materials sources must be situated close to the plant. In addition, they must be available in sufficient quantity and purity. Accordingly, surveys of deposits of sand, for instance, are carefully made, and impurities studied. The reactions of the material to various purifying processes, such as magnetic separation, washing, acid purification, or flotation, etc., are carefully studied. Grinding and sizing problems are also studied. Two areas are available for this work—a strictly bench type, in the laboratory, and a semi-pilot type, in the low-bay pilot plant.

In the testing of refractories, it has always been the desire to develop a small regenerative-type glass furnace which could be run just like a large furnace. Duplication of commercial tests would then be possible on a pilot scale and for a reasonable cost. Such a furnace has been running for several years, Fig. 14. It has been through several campaigns and proven very useful for tests both above and below the glass line and on checkers. In addition, several different type glass compositions can be used at reasonable cost.

The illustration shows the general layout. Fig. 15 shows a series of blocks after test. Note how closely the blocks resemble commercial scale tests.

So far we have described activities which might be roughly designated as Materials Research, as approached from several different angles, physical, chemical, etc.

Closely allied with this are two development groups working on processes and products. Naturally all these activities are interrelated and require close coordination.

Process Research

In Basic Process Research and Development we work on new processes related to the manufacture of articles such as bottles but not with supplemental processes. It is concerned with the initial forming stages of groups or families of articles, such as wide-mouth bottles, say from 4 oz. to 32 oz. capacity, or tubing, say from 5 mm. to 50 mm. in diameter.

Processing studies of presently accepted processes are made to determine the reasons for variability of the product. The various weaknesses in present processes are analyzed and broken down into fundamental causes. Oftentimes, the first step is a critical analysis and experimental study of the present commercial process. Such a history was experienced in developing the new experimental container forming machine.

The experimental container machine has been developed over the last twelve years. It is built around a basic principle that the behavior of glass in the forming stage is largely dependent on how it cools. In the early work on glass composition in relation to properties, we applied the results to manufacture of glass containers, essentially by formulations which could be fabricated much faster. A point was reached where we were sure we needed more factual information on the glass and mold

(*Continued on page* 644)

Fig. 15. A typical layout of refractory test blocks after an extended run in the small regenerative test furnace. Note the corrosion is very similar to large block in commercial furnaces.

Current Status Of Electric Booster Melting

By LARRY PENBERTHY
Penberthy Electromelt Company, Seattle 16, Washington

● ELECTRIC MELTING of glass is a subject both old and new. It has intrigued glass people for many years. This is not a historical paper, but a few dates will be given to illustrate this point.

One of the first patents on this subject in this country was taken out by Sauvegeon in 1913. Between that time and 1930, more patents were issued, including several to inventors in Norway, Sweden and Switzerland. During the 1930's, several Americans were very active patentwise, including Ferguson, Hitner and Wadman, and considerable experimental work was done. The basic electric booster patent was issued to Wadman in 1934. An all-electric container tank was built by Northwestern Glass Company in 1945. Yet, the widespread use of electric booster melting in the United States did not begin until late 1952. This paper is primarily a report on the status that electric boosting has achieved here since that time. For information as to early foreign practice, please refer to a series of articles by Horowitz in THE GLASS INDUSTRY magazine starting February, 1953.

The idea of electric booster melting lay nearly dormant during the entire life of the patent. This was largely due to the abundance of natural gas as a fuel, with a strong assist from the refractories suppliers and combustion engineers, who made it possible for furnaces to deliver the extra glass that newer and faster machines were demanding. There was simply no need for electric boosting.

In recent years, however, this situation has been changing. Gas prices are going up and supplies less reliable. Whereas machines continue to need glass at ever higher rates, most tanks are working near their melting limit by normal methods. Accordingly, electric boosting appears to have a worthwhile place among the tools of the glassmaker.

Definition

Before proceeding, perhaps we should define electric boosting and review how it works. Electric booster melting is the process of adding heat electrically to a glass tank that is normally fired with burning fuel, said heat being introduced beneath the surface of the glass. I used to limit the definition further by saying that the increase in tonnage output of the tank should not exceed about 40 per cent, simply because boosters larger than that requires more attention. It is my philosophy that a booster should be able to run by itself, with no other control than an on-off switch. Recently, however, we have developed low-cost automatic control equipment that permits increases in tonnage output of a tank up to 60 per cent above the fuel-fired capacity.

Presented before the Glass Conference, Ohio State University, Dec. 3, 1954.

The principle of electric boosting is quite simple. As you know, glass, when hot, will carry an electric current, but not so well that it would be classed as a good conductor. Instead, it would be called a good resistance element. The resistance between electrodes immersed in the glass on opposite sides of a tank is in the order of 100 times as much as the resistance of the copper cables bringing the electricity to the tank. Thus, when an electric current flows in the circuit, 99 per cent of the energy is released as heat *inside* the glass itself.

Number of Tanks

The number of tanks using boosters today is about 30 to 40, a figure arrived at by generous use of hearsay and guesswork. I have accurate knowledge of less than half of these. My guess as to the total power input is 10,000 kilowatts. If this power figure is right, the output of extra glass is about 200 tons per day.

Business Purposes

It is apparent that the amount of glass produced by boosters is not yet very great as compared to fuel-fired tonnage. However, these boosters were more important to profits than might appear at first glance, because they were put in strategically. Each one filled a specific need. Most of them were used to boost the output of a given tank, well above its break-even point, as to expenses *vs* income. This situation is very profitable as you already know. Some of these boosters were put in to improve glass quality. Others were put in to save freight on shipping the same weight of glass from another factory location. For example, $8 per ton freight on 30 tons a day mounts up to quite a saving in a month. Other boosters were put in to obtain extra glass quickly to avoid losing customers.

Applicability

Boosters have now been put in tanks ranging from 3 sq. ft. to 1,240 sq. ft. melting area. Most tanks have been in the 300-700 sq. ft. range. One important conclusion has been derived from this broad variety of tanks, namely, that the size of the tank doesn't influence the results to be expected. The rule-of-thumb for container quality is that you can get 5 more tons of glass per day for each 100KW of steady input, making the power input 2400 KWH per day. This ratio stays the same from tank to tank. It is reasonable that this should be so because the electric heat is liberated inside the batch and glass. A given amount of heat melts a certain amount of glass. No transfer of heat through a surface is involved.

(*Continued on page 647*)

Materials and Manufacture Discussed at West Coast Meeting

● SEATTLE WAS HOST to about 300 ceramists during the Eighth West Coast Regional Meeting of the American Ceramic Society held October 27, 28 and 29, with very good attendance from Southern California and from the East. It was a highly successful convention from the viewpoint of the glass section and others interested in the progress of the glass industry.

The first glass session was devoted to certain aspects of materials and production of immediate interest to the industry, namely sand, spray-coating of containers and the use of silicones in the blow-room to minimize smoke and fumes.

The difference between most eastern glass sand operations and those along the Pacific Coast lies in the fact that most western sands are feldspathic by nature and those in the east are of the high silica type. These differences were brought out in V. C. Swicker's review of the 1955 situation. It was emphasized that the glass sand situation in California has been changing very rapidly during the past year and that this change is intensifying. New deposits have been opened up, a new processing plant has been completed in Ione and is in operation. A sand plant is being constructed at Comanche near Stockton and another plant is being modernized. One plant has been abandoned after a very short period of operation and some of the well established plants face a lower volume of business.

Mr. Swicker described both physical and chemical aspects of deposits in the Northwest and included slides of the Crystal Silica Company operation in Oceanside, California. The only sand plant in Washington that supplies glass sand is located in Auburn about 50 miles from Seattle. This plant, known as the Hammer Bluff deposit, supplies sand for the manufacture of amber glass. It is now in the process of being relocated and modernized.

Unsuccessful attempts have been made from time to time to construct a plant at Springdale, Washington, but beneficiation equipment was not adequate to produce a sand generally acceptable to the glass industry.

The sand deposit at Emmett, Idaho is the most impressive but at the same time is farthest removed from markets. An unlimited supply of sand is available in this deposit.

Feldspathic sands usually require beneficiation for the removal of heavy minerals and for control of alumina content. W. S. Stickney, of the U. S. Bureau of Mines, discussed flotation operations with particular reference to removing the iron bearing constituents and referred to work on beach sands where the iron oxide content was reduced to below 30 per cent. The speaker emphasized the need for removing all clay-like material before submitting the sand to the various flotation chemicals and commented on the economics of this kind of processing.

The third paper, by E. G. Tajkowski of the General Electric Company, dealt with three critical aspects of glass plant operation, namely, spray coating of containers, trough and mold sprays and high temperature lubricants of the silicone type.

Spray coating of containers by sulphur and other chemicals has been practiced for many years, but the application of silicones is a relatively new development. The speaker, confining his remarks to the use of silicones, reviewed the chemistry of silicones, methods of application and the effect on the serviceability of containers, citing the advantages to both one-trip and returnable beer bottles. Retention of strength by protecting the pristine surface is now being taken advantage of by many glass manufacturers and also by some packers who request spray coated bottles.

The Los Angeles smog situation is becoming increasingly critical, for which reason all glass manufacturers are attempting to reduce smoke and fumes in the forming departments by taking advantage of silicone sprays. Some eastern plants have improved conditions by using a silicone-graphite spray on delivery troughs and blank mold equipment. Unfortunately, the "hard" water in the Los Angeles area presents serious problems that makes it difficult to take full advantage of the materials that work satisfactorily in other areas. Glass plant operators are very much concerned about this situation, as not only are smoke and fumes detrimental to the health and efficiency of the blow-room personnel, but also tend to become a violation of smog control requirements.

Larry Penberthy, of Penberthy Electromelt Company, described methods by which hot repairs at tanks can be made to increase safety to workers. The methods suggested included the use of thin sheets of aluminum to cut down radiation, aluminum helmets, spraying gloves with aluminum paint, the use of metal chain screens and improved protective clothing. Use of aids of this nature will increase the efficiency of the repair men and will improve employee relations.

Ed Humphrey, of Corhart Refractories Company, reviewed some aspects of currents in glass tanks and their relation to the selection of refractories. Examples were cited and corrective measures were discussed. Another paper dealing with refractories was presented by W. C. Pittman, of Charles Taylor Sons Incorporated. Mr. Pittman discussed both mullite and zircon refractories, emphasizing in particular the use of zircon paving block.

The entire glass industry is interested in applications of electric power melting. In this field the Northwestern Glass Company is a pioneer. Edward S. Campbell, president, discussed the current status of electric melting at Northwestern, starting with their original experiences about 1945 with a 16 ton furnace. Much experimenting

(*Continued on page* 657)

Some Practical Aspects of Seeds and Fining

A SUMMARY OF A GLASS CONFERENCE PAPER

By JOSEPH W. WRIGHT
Owens-Illinois Company, Toledo, Ohio

Many authors have discussed the possible origin of seeds in glass, but no attempt is made here to elaborate on these thoughts. We cannot disregard the causes of seed that have been enumerated by prior authors. Precautions should be taken to eliminate those conditions that do cause seed, such as batch separation, which is considered one of the major reasons for seedy glass. I do not believe we have reached all the answers to our problem, hence, the quicker we can diagnose our problems correctly the sooner somebody will find the cure. I am not going to tell you how to eliminate seeds, or even theorize to any extent on the cause of seeds. I propose merely to cover some observations and experiences. From these I would like to venture a guess. The guess is that undecomposed sulphates or sulphites present within molten glass are our principal source of troubles insofar as seeds are concerned.

I believe many glass factories adopt certain practices based upon experience that indicate improvements in their operations. As an example, let us recall an incident from the days of pot-melting where amber glass was melted in a covered pot. As the blowers gathered the glass from the pot, it would become seedy and blistery when the pot was partially worked out, necessitating that the pot be closed and either refilled or reheated for a period of time, then cooled to operating temperatures again, whence additional ware could be produced. On one occasion a furnace man had not opened the pot early enough so as to allow the glass to cool to the desired working temperature, therefore he moved a cooling fan into the proximity of the pot and then forgot to watch the glass, with the result that the glass in the pot cooled down considerably below operating temperature. This, then, necessitated that the pot be closed and allowed to reheat until it reached operating temperature. In this particular case, the blowers worked the pot of glass to the bottom without encountering troubles that were characteristic in the past. Needless to say, from that time on, furnace men adopted the practice of cooling amber glass pots below their normal working temperatures, then allowing them to reheat, thus obtaining better production figures.

When the quantity of glass required for an operation is known, the glass tank size is determined on the basis of past experience. Unfortunately, the same size of tank furnace does not turn out equal quantities of good glass in all cases. Naturally, the glass composition and glass color are major factors influencing the output of a tank furnace but, in addition, there are many other factors influencing the output. I do not know how to evaluate these factors. nor am I certain we know all the factors involved.

As a result of feeding batch into a tank furnace through the endwall by means of two continuous screw feeders, the batch stream traveled in all directions and seedy glass appeared periodically. As an experiment, the batch was fed from the sidewalls immediately adjacent to the endwall. The batch did not travel out from the endwall and disappeared without moving out under the flame of the side port furnace. Approximately 90 per cent of the melter surface was batch free, but seediness increased in the ware made by the Owens machine.

A molten glass that appears satisfactory in an average size container when made on a gravity fed machine may not be at all suitable for a similar size container when made on the vacuum fed machine. The rotations of the pot and the Owens machine are synchronized so as to create the least possible agitation within the pot; however, the molten glass within the pot becomes extremely seedy at times. We have adopted a term for this type of seed in the glass, calling it breakdown; thus the term indicates that the glass could be fairly seed-free as it enters the pot but in production operation the glass has become filled with fine seed. This is not to be confused with "reboil" as reboil is the release of many blisters and seeds at the surface of the glass when the glass is subjected to a sudden increase in temperature or to a poor firing condition (i.e., shortage of oxygen). Indications are that a glass that will reboil easily will show breakdown also in the Owens process.

The tendency for this so-called breakdown can be minimized by the furnace man by means of a temperature gradient on the furnace. If ladle samples of glass from the refiner are practically free of visible seeds the temperature of the bridgewall is lowered. If, after some time, the glass samples from the refiner show few visible seeds the containers made on the Owens machine can be good. The bridgewall temperature cannot be lowered excessively, otherwise the glass will become extremely seedy within the refiner. However, experience has shown that samples of glass from the refiner can show no seed to the naked eye but the glass can show excessive breakdown in the revolving pot. It is not uncommon to encounter as much trouble in a lightly pulled furnace (no visible seed) as when the furnace is pulled beyond its capacity.

At low pulls the glass batch does not move very far out into the furnace and it is probable that partially molten glass is sinking at the charging end of the furnace and thus travelling under the surface toward the throat. The flame and furnace atmosphere does not have an opportunity to act upon the batch materials. The importance of these convection currents is shown in the case of a green glass which according to laboratory

(*Continued on page* 650)

Inventions and Inventors

Feeding and Forming

Apparatus for Forming Glassware. Patent No. 2,702,444. Filed July 9, 1949. Issued February 22, 1955. Twelve sheets of drawings (none reproduced). Assigned to Emhart Manufacturing Company by George E. Rowe.

The present invention relates to the production of blown glassware by forming machinery in which blanks or parisons are formed in blank molds, transferred to finishing molds and are there blown into final shape. The machine provides forming sections which have a plurality of simultaneously operable blank molds and blow molds together with operable forming means associated with each mold. There are also provided means for discontinuing the operation of the forming means associated with one blank mold, without discontinuing the operation of the forming means associated with another blank mold. The machine also has blank and blow molds for selectively forming glassware by blow-and-blow and by press-and-blow operations.

A novel cooling system for controlling the temperature of various parts of the forming machine, especially the blank, blow and neck ring molds, is provided. This is accomplished by mold holder arms for receiving cooling air from a common air chest and a timer controlled valve for individually regulating the air supplied through each arm to the mold sections. Means are also provided for accurately controlling the extreme positions of the transfer-invert and its neck ring molds relative to the blank and blow molds and the acceleration and deceleration of the transfer to and from those positions. The machine may be operated either as a "blow-and-blow" machine or as a "press-and-blow" machine. It may also selectively be employed as a "single gob" and a "plural gob" machine. The changes required comprise only substitution of molding parts and the operation of adjusting means built into the machine to vary the operation from one type to another.

The patent contains 18 claims and 25 references were cited.

Apparatus for Preparing Glass for Working. Patent No. 2,700,850. Filed May 18, 1951. Issued February 1, 1955. Three sheets of drawings (none reproduced). Roy H. Dreshman.

This invention relates generally to apparatus for preparing glass articles to work the same and more particularly to machines for providing relative oscillating motion between the glass articles and the source of heat applied thereto in preparing it for working. The burner or electrode completely surrounds the article to provide a continuous source of heat and either the burner or the article oscillates, or both are oscillated in the same direction at different speeds or in different directions at the same or different speeds, to unify the distribution of heat over the surface to be worked. The construction of the burner or electrode should be such that the flames or contact points are relatively close to each other, completely encircling the article and providing enough clearance space so that the degree of oscillation does not carry the surface too far beyond or into the hottest zone of the flame due to the shape of the article. A rotary drive is provided for selectively rotating or oscillating the ware, or the burner, or both, which drive includes a clutch having cams adjustable to produce the oscillations in various increments of amplitude from zero to the summation of the longest arm length of the cams. This drive permits the structure to be adaptable to various sizes and shapes of ware and burners. The apparatus is particularly adapted for use in working non-round articles or in cutting odd shaped holes in the side of a glass article.

The patent contains 11 claims and the following references were cited: 1,577,538, Parker, Mar. 23, 1926; and 272,308, Great Britain, June 15, 1927.

Furnaces

Glass Level Control Apparatus. Patent No. 2,716,498. Filed April 26, 1952. Issued August 30, 1955. Three sheets of drawings (none reproduced). Assigned to Westing house Electric Corporation, by Gordon E. Childs.

This invention relates to automatic control apparatus for maintaining molten glass in a melting tank or furnace at a desired level.

An automatic glass level control apparatus is provided consisting of two main assemblies; a probe assembly for measuring the existing glass level and an electric control mechanism for adjusting the batch feeding rate to maintain the desired level.

This probe may be of any suitable heat-resisting construction which will satisfactorily conduct an electric current on making contact with the surface of the molten glass. It is mounted so that it is movable up and down by any suitable source of power. The probe assembly itself contains a gaging unit made up of four relay-control switches and a limit switch, which are operated by an extension yoke attached to a probe push-rod, with the limit switch stopping the probe when it is withdrawn from the glass after gaging the level.

In operation, the initial adjustment of the timer sets the duration of a complete cycle. The probe power source is started near the beginning of each cycle by the first section of the timer, in conjunction with one of the latching relays. The probe moves down until it contacts the surface of the glass and the electric current, which then flows, releases the latching relay, thereby reversing the direction of travel of the probe until it is stopped by the upper limit switch. Means is thus provided for gaging the existing level of molten glass and adjusting automatically the batch feeding rate to compensate for variations in the glass level.

There were 5 claims and 4 references cited in this patent: 1,961,893, Wadman et al., June 5, 1934; 2,565,136, Kretzmer, Jr., Aug. 21, 1951; 2,585,607, Whitmore et al., Feb. 12, 1952; and 2,613,002, Light et al., Oct. 7, 1952.

Apparatus For Melting Glass. Fig. 1. Patent No. 2,718,096. Filed July 17, 1947. Issued September 20, 1955. One sheet of drawings. Assigned to Union des Verreries Mecaniques Belges, by Georges Henry, and Edgard Brichard.

The present invention relates to an apparatus for the manufacture of glass and like products and it has for its object to improve the thermal efficiency of the fusion of these materials.

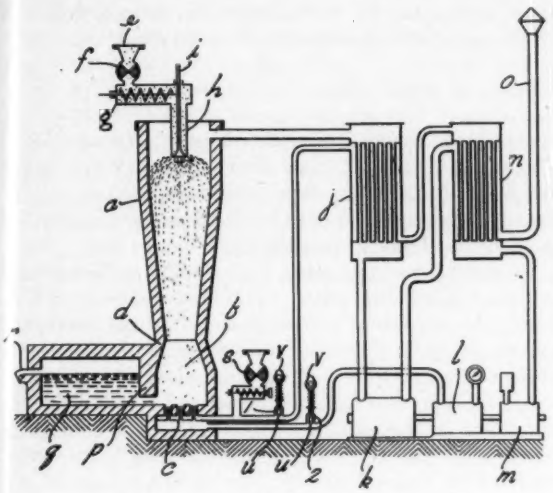


Fig. 1

The accompanying Fig. 1 illustrates a shaft furnace (a) at the bottom of which is a melting pot (b) containing the molten glass through which pass flame jets. The gases are blown at high speed and pressure through nozzles (c) comprising two concentric pipes, one for the combustion air, the other for the fuel.

After having yielded a part of the heat to the molten bath, the fumes travel in contra-current to and heat the raw materials falling as a spray in the shaft (a).

The raw materials are charged into a hopper (e) provided with a rotating feeder (f) which permits admitting them into the furnace in spite of the higher pressure therein.

Above the constriction (d) the shaft flares upwardly, so that the rate of flow of the fumes decreases as they rise and opposite the fumes outlet it is so low that no part of the raw materials is carried towards the recuperators.

As they come out of the shaft, the fumes enter a recuperator (j) in which their pressure and rate of flow are still sufficiently great to ensure an efficient heat exchange with the combustion air. They are then expanded in a gas turbine (k) which drives the air blower (m) and gas blower (l). On leaving the gas turbine the fumes pass through a second recuperator (n) and then are let out to the atmosphere through (o).

The combustion air compressed by the turbo-blower (m) successively passes through the recuperators (n) and (j), and arrives at high temperature in the air chamber for the nozzles (c). A distributor with fluid-tight feeding chamber (s) permits of introducing into the air pipe reagents in the form of very fine powder.

The fuel gas compressed by the turbo-blower (l) is sent to the gas chamber for the nozzles (c).

The glass melted in the furnace passes under a wall (p) into a refining zone (q) where occluded bubbles are allowed to escape; it is collected at (r) or directed towards shaping or other apparatus.

There were 4 claims and 3 references cited in this patent: 351,413, Wainwright, Oct. 26, 1886; 2,131,599, Shrum, Sept. 27, 1938; and 651,687, Germany, Oct. 18, 1937.

Glass Compositions

Fluoroxide Glass Composition. Patent No. 2,716,069. Filed July 27, 1948. Issued August 23, 1955. Three sheets of drawings (none reproduced). Assigned to American Optical Company by Alexis G. Pincus.

One of the principal objects of the invention is to provide glasses whose index of refraction is considerably below known commercial glasses, whose index of refraction and reciprocal relative dispersion properties may be varied with respect to each other over a broader range than has heretofore been available, whose chemical durability will be adequate to meet the requirements of particular uses, and which are readily workable and afford ease of fabrication and refrabrication.

Selected examples from the numerous glasses prepared within the field are as follows:

	Approximate Percentages by Weight				
	Batch 1	Batch 2	Batch 3	Batch 4	Batch 5
Beryllium Fluoride (BeF_2)	40	30	20	10	30
Sodium Fluoride (NaF)	20	10	20	..	20
Sodium Metaphosphate ($NaPO_3$)	20	40	30	40	..
Aluminum Metaphosphate $Al(PO_3)_3$	20	10	30	50	50
Refractive Index Index (N_D)	1,389	1,434	1,440	1,511	1,428
Nu	81	71	68	71	72
Durability Rating	2	1	1	1	1

Glasses of the present invention open an entirely new field of research as to optical systems and lens design in general and lend themselves to several different applications. For examples of particular uses: such glasses may replace crystals in highly corrected lens systems; may be used as an intermediate medium for supporting the elements of different lens systems in more positive relation with each other and at the same time replace the conventional air spaces of the elements of such systems with a less abrupt interfacial transition in refractive indices; and will afford other design possibilities which can take advantage of their unique optical characteristics.

There were 11 claims and 1 reference cited in this patent. 2,481,700, Sun et al., Sept. 13, 1949.

Glass Wool and Fiber

Glass Fabric Structure and Method. Patent No. 2,703,774. Filed November 18, 1949. Issued March 8, 1955. One sheet of drawings (none reproduced). Assigned to Owens-Corning Fiberglas Corporation by Albert R. Morrison.

This invention relates to the manufacture of vapor

permeable, water repellent fabrics and more particularly to the combination of glass fibers and resinous materials or elastomeric materials or products possessing the desirable properties of leather. The materials are characterized by high resistance to the penetration of water while permitting transmission of vapors to enable the material to breathe when used as wearing apparel in the form of shoes, jackets or when used as a leather substitute in the manufacture of purses, luggage, and the like. The following example demonstrates the principles of manufacture:

Continuous strands of Saran (polyvinylidene chloride) and glass fibers in the ratio of about 1 to 4 in haphazard distribution are fed downwardly upon a collecting belt traveling substantially at right angles to the oncoming fibers at a linear speed which is less than the rate at which the fibers are fed. As a result, the separate strands form into natural spirals upon the belt to form "swirl mat." Integration of fibers one with another is effected by an adhesive of the type formed of butadiene-acrylonitrile elastomer in combination with equal parts compatible phenolic resin. Ordinarily, 5 to 20 per cent by weight solids adhesive is sufficient. The diluent is removed by air drying or it may be driven off at a temperature below that at which molecules of Saran are capable of readjustment, such as at a temperature below 200° F. Subsequently, the "swirl mat" is heated to a temperature of 300° F. for 8 seconds during which the Saran fibers shrink to much smaller lengths, with a resulting looping of the glass fibers between anchored junctures.

The patent contains 9 claims and 11 references were cited.

Feeder for Molten Thermoplastic Material. Fig. 2. Patent 2,706,365. Filed February 18, 1954. Issued April 19, 1955. Two sheets of drawings. Assigned to Owens-Corning Fiberglas Corporation by Charles J. Stalego.

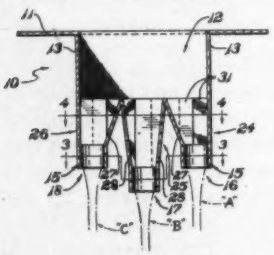


Fig. 2

This invention relates to a feeder designed for continuously producing streams of thermoplastic material, for example glass, from which filaments of considerable diameter say, .015" can be continuously attenuated. The individual orifices are so formed as to result in a controlled radiation of heat away from the orifice forming structures, thereby carrying heat out of the glass at a controlled rate as it passes through and out of the orifices. The feeder structure is relatively inexpensive to construct and can be fabricated to controlled dimensions and wherein each orifice is separated from its neighbor by a minimum of material, but in such a manner as to inhibit the tendency of the glass to wet the surface of the material, and thus to link adjacent streams to each other. The combination of the cross fins 31 is shown in Fig. 2 and the vertically staggered positioning of the central series of orifice elements 17 and side series 16 and 18 results in there being substantially uniform glass conditions at the ends of the orifice elements 15. Thus when all of the filaments in the series A, B and C are pulled at a uniform rate of speed and to the same points, the controlled radiation of heat resulting from the feeder design embodying the invention produces filaments of uniform cross section from all three series of orifice elements 16, 17 and 18.

The patent contains ten claims and the following references were cited: 2,229,489, Barnard, Jan. 21, 1941; 2,303,657, Parsons, Dec. 1, 1942; 2,306,164, Harrison, Dec. 22, 1942; 2,335,135, Staelin, Nov. 23, 1943; 2,407,295, Simison et al., Sept. 10, 1946; 2,485,807, Berthold et al., Oct. 25, 1949; 2,489,508, Stalego, Nov. 29, 1949; and 2,634,553, Russell, Apr. 14, 1953.

Sheet and Plate Glass

Automatic Grinding and Polishing of Glass Surfaces. Patent No. 2,705,853. Filed December 4, 1951. Issued April 12, 1955. One sheet of drawings (none reproduced). Assigned to Les Glaceries de la Sambre, Societe Anonyme by Edmond Laverdisse.

In plants for surfacing, i.e. for grinding and/or polishing glass in the form of a continuously moving endless band, the movement of the glass is usually imparted thereto by pairs of driving rollers inserted between successive grinding tools and between successive polishing tools. In both cases the pressure exerted by the tools acting either on one side, or simultaneously on both sides of the glass, has a braking effect that gives rise to very considerable internal stresses, capable of breakage of the glass. To avoid this inconvenience, surfacing tools are arranged across the side edges or margins of the glass sheet, so that they project beyond the edges and variable speed driving means are provided for driving in opposite directions the tools projecting beyond opposite edges. The arrangement may be applied to plants of various existing types as those having rows of tools mounted on stationary or on reciprocating beams and those having tools working over the whole width of the endless glass sheet, whether the surfacing operation be carried out successively or simultaneously on both sides of the sheet.

The patent contains one claim and the following references were cited: Re. 18,533, Drake et al., July 19, 1932; 1,729,498, Waldron, Sept. 24, 1929; 1,803,752, Ford, May 5, 1931; 1,864,823, Heuze, June 28, 1932; 2,181,241, Klemm, Nov. 28, 1939; 2,272,651, Waldron et al. Feb. 10, 1942; and 2,304,974, Waldron et al. Dec. 15, 1942.

Method of and Apparatus for Cutting a Moving Ribbon of Glass. Fig. 3. Patent No. 2,705,390. Filed October 9, 1953. Issued April 5, 1955. Four sheets of drawings. Assigned to Pilkington Brothers Limited by Peter M. Denlow.

The principal object of the invention is to provide a method of and an apparatus for producing glass sections in sheet form of predetermined dimensions from a moving ribbon of glass, whereby the transverse and longitudinal score lines are formed in the moving ribbon of glass and so to arrange the score lines that irregular breaking of the glass does not occur. Below the transverse scoring device 7, Fig. 3, are provided three retractable scoring devices 17, the number of such devices depending on the number of sections in sheet form into which a leading portion of the ribbon 1 is to be

divided. Each of the scoring devices 17 is supported by the cross bar 22 (not shown) and a bail 30 common to the devices 17 is provided to retract simulantaneously the devices from operative engagement with the ribbon 1, the bail 30 being movable to engage the lower ends of the arms 18 and swing them anti-clockwise. Operation of the bail 30 is initiated by a mercury switch 42 pivotally supported by the post 11 for engagement by the leading edge of the ribbon 1 at a predetermined distance in advance of which the switch 10 is engaged by the leading edge of the ribbon. The switch 42 is so spaced from switch 10 that it initiates operation of the bail 30 to retract the scoring devices 17 from the ribbon at the predetermined position on the ribbon in advance of that at which the ribbon is to be engaged by the transverse scoring device 7. The switches 10 and 42 are adjustable lengthwise of the post 11, a wing-nut 43, permitting adjustment of the switches roughly to determine the position at which switch 10 will be engaged by the leading edge of the ribbon 1 and adjusting screws 44, 45 permitting respectively fine adjustment of the height of switch 10 and adjustment of switch 42 relative to switch 10. When the leading end portion of the ribbon reaches a predetermined position it is snapped off the ribbon along the transverse score line.

The patent contains six claims and the following references were cited: 1,855,078, Williamson, Apr. 19, 1932; and 2,260,103, Hinkle, Oct. 21, 1941.

Double Grinding or Polishing Flat Glass. Fig. 4. Patent No. 2,709,875. Filed January 25, 1951. Issued June 7, 1955. Three sheets of drawings. Assigned to Pilkington Brothers Limited by Robert Touvay.

This invention relates to apparatus for grinding, lapping or polishing the surface of flat glass, and which acts simultaneously in continuous progression on the two faces of a continuous ribbon of glass, in accordance with the method known generally as the "continuous grinding-polishing of two faces." The support 4 for the lower tool 1 is provided with shoes 13, Fig. 8, which rest and slide on guide elements formed as tracks 14 forming part of angle irons 15 secured to horizontal girders 16 joining pillars 17 at opposite sides of the machine. Movement of the support along the tracks 14 is effected by an electric motor 18 mounted on the support and transmitting motion through a chain 19 to a shaft 20 provided with screw threads which mesh with a toothed wheel 21 keyed to a shaft 22. The shaft 22 is supported in bearings 23 and at its ends is provided with screw threads 24 (not shown) meshing with toothed wheels 25 secured to shafts 26. Secured to the shafts 26 are toothed pinions 27 which mesh with toothed racks 28 secured to the angle irons 15 and extending lengthwise thereof. The gear trains connecting the motor 18 with the racks 28 are reduction trains so arranged that the transverse movements imparted to the support 4 are slow as compared with the rate of rotation of the tool 1 supported thereby and reversing switches control the direction of rotation of the motor 18 so that the support is oscillated along the tracks 14 to obtain a rubbing action of the tool which is the resultant of the rotary movement thereof and of the

(*Continued on page* 652)

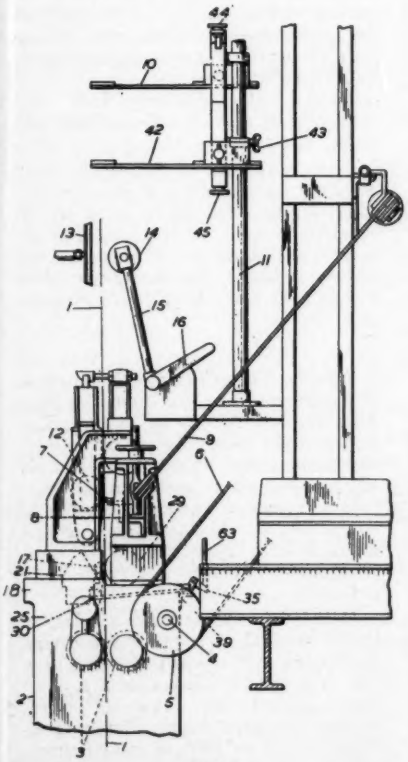


Fig. 3

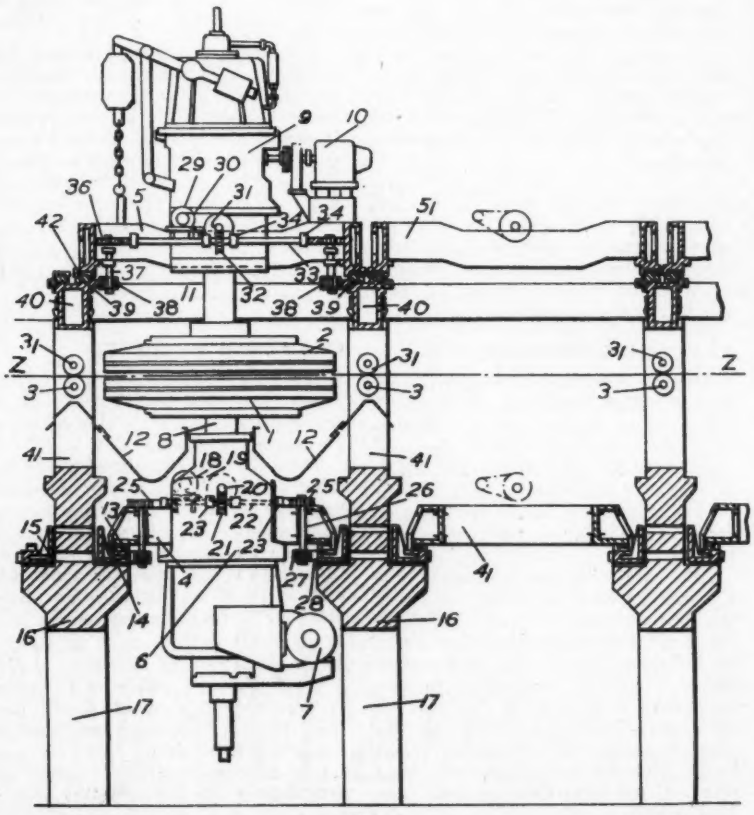


Fig. 4

New Equipment and Supplies

AXIAL AIRFOIL FANS

The Chicago Blower Corporation, 9869 Pacific Avenue, Franklin Park, Illinois, have just announced their newly redesigned, improved line of Axial Airfoil Fans.

These heavy-duty fans are designed in eight general categories for ventilating under all kinds of conditions. Developed after more than 50 years of research, these fans provide high efficiency and low noise level. Of heavy steel construction, they are available with direct or V-belt drive.

An illustrated bulletin AA-101, which explains their function and design in detail, may be obtained by writing the Chicago Blower Corporation, on company letterhead.

CONTAINER STAPLING MACHINES

Container Stapling Corporation, 308 North Park Avenue, P. O. Box 247, Herrin, Illinois have just announced their newly designed Model CSC-2. This machine staples tops and bottoms, simultaneously, of center slotted corrugated and fibre board boxes after they have been packed. Equipped with two stapling heads, air operated with fully pneumatic controls, Model CSC-2 has no electrical connections, i.e., no relays, no solenoids, no micro-switches, no fuses, etc. The air valves are operated by completely mechanical means.

This machine was designed by Werner Schafroth and manufactured exclusively by Container Stapling Corporation.

The range of carton sizes which may be closed with this model is equalled by no other machine of this type on the present market. It is designed with safety features which insure rapidity of operation without danger of damage to cartons or machine.

ELECTRO-STOPSWITCH

Fisher Scientific Company, 717 Forbes Street, Pittsburgh 19, Pennsylvania, have announced an Electro-Stopswitch 4″x4″x4″ which is designed specifically for laboratories and which is available in 60-minute and 24-hour models. Each, of course, can be used for any fraction of these maximum periods.

After use with one instrument, the Electro-Stopswitch is quickly used with the next instrument, none of the expense of furnishing each appliance with an individual timer. The user merely makes electrical connection to the heavy-duty receptacle in the rear of the Electro-Stopswitch and sets the desired operating period on the timer knob. When the cycle is over, the timer turns off the apparatus (and its own pilot light).

AUTOMATIC GLASS CUTTING MACHINE

Biddle Engineering Company, Box 15, Warrendale, Pennsylvania, has designed and built an automatic glass cutting machine that both cuts and "cracks off" glass. It replaces time-honored hand operations in glass production.

According to Biddle engineers, this new product is the first glass cutting machine that can do both jobs automatically, not only cutting a pattern but also "cracking off" unwanted glass from the desired shape.

The Biddle machine is already available in a series of sizes capable of automatically cutting and "cracking off" glass circles and other patterns from two to six inches in diameter. Equipment will be supplied for cutting and "cracking off" even larger designs.

The machine can be furnished with automatic loading and unloading equipment to make the entire operation automatic. Capacity of the new machine is approximately 1,200 pieces per hour —an advantage of as much as 100 per cent over present hand "cracking off" processes used in production of automobile glass, mirrors and other glass items.

Further details can be secured by writing the company.

CATALOGS RECEIVED

Coast Metals, Inc., Little Ferry, New Jersey, have just issued literature describing their newly developed line of hardsurfacing alloys.

These materials consist of alloy-filled tubes, either in coils for automatic welding, or cut to length for manual application. The alloys and methods of their manufacture were developed through two years of research and field test, to meet the demand for higher alloy hardsurfacing at low prices.

Linde Air Products Company, a division of Union Carbide and Carbon Corporation, 30 East 42 Street, New York 17, N. Y. have just published an 8-page bulletin about their six new organo-silicone compounds with unusual lubricating and solubility properties which have been developed.

Designated X-520, X-521, X-522, X-525, X-526 and X-527 these chemicals are offered for development purposes and are also available in commercial quantities. Since they possess many properties which hitherto have not been available in the silicones, it is expected that they will find broad industrial uses as special lubricants, as release agents for rubber and plastics; in cosmetics and as emulsifying agents or emulsion breakers. Copies of this bulletin can be obtained by writing to the Silicones Department.

Stephens-Adamson Mfg. Company, Aurora, Illinois, announces the availability of a new Belt Conveyor Carrier bulletin covering the company's line of standard units. New addition to the S-A line is a long center roll carrier with either 35 to 45 degree slope end rolls for greater carrying capacity on light materials, such as grain and wood chips. In addition, the new bulletin describes a number of special carrier units, as well as Belt Conveyor Trippers and accessories. Write for Bulletin #355.

Johns-Manville, 22 East 40 Street, New York 16, New York, has published the "Johns-Manville Products Handbook," a new 52-page publication featuring eleven lines of J-M products for industry—insulations and refractory products; transite asbestos-cement pipe; packings and gaskets; electrical products, celite diatomite filter aids and mineral fillers; J-M synthetic silicates, etc.

The handbook contains not only product descriptions and essential engineering data but also a great deal of valuable related information. For instance, on the subject of thermal insulation problems, the handbook gives methods of calculating heat transmission, etc.

Superior Tube Company, Norristown, Pennsylvania, have just published Data Memorandum No. 15 on glass sealing tubing made from constant or uniform expansion alloys. The data covers six glass sealing alloys in standard production at Superior. The alloys are No. 42 Alloy, No. 52 Alloy, Sylvania No. 4 Alloy, A.I.S.I. Type 446 (27 per cent chromium), MT 1010 and OFHC Copper.

Included in the data are production limits, nominal chemical analysis, temper ranges, mechanical properties, thermal properties and tolerances. A chart shows approximate expansion curves for the six standard alloys for temperatures from 0 to 1000 degrees Fahrenheit.

Research Digest

Annealing of Glass by T. M. Lehrs

A glass-annealing lehr employing a new system of sectionalized and controlled convection heating is described by Messrs. Chudde and Adeline in the News and Reviews section of the April 1955 issue of the *Journal of the Society of Glass Technology*.

The different characteristics of this T. M. (Travaux et Métallurgie) lehr are as follows:

(a) The application of forced convection currents transversely to the direction of the flow of glassware through the lehr.

(b) Exact control of temperature throughout the length of the lehr, temperature regulation conforming to pre-determined temperature curves being sectionalized by individual unit or zone control to suit the character of the glassware.

(c) Accelerated cooling.

(d) All-metal and unit construction, with accessibility providing ease of maintenance during operation.

The use of forced convection assures uniformity of temperature through all sections of the lehr and also eliminates the deficiencies and inconvenience of heat by radiation. The heat which is transferred from the heating elements to the glass is almost entirely by convection, the transfer of heat by radiation being practically nil. The same process is reproduced inversely at the cooling stage, the rapidly circulating air removing the heat from the glass. In addition to these important advantages, the heat exchanges are considerably accelerated, resulting in greater uniformity of temperature, due to the rapid diffusion of heat from the heating elements to the glass.

During annealing, it is obviously essential to impose on the glass a temperature cycle which corresponds with its physical and chemical characteristics and with its shape, so as to insure that the glass acquires its desired properties. The looked for in well-annealed glass, however (absence of strain, uniform distribution of strain, surface brilliance, etc.), cannot be obtained without previously determining the time/temperature annealing curve which, in turn, is either calculated or obtained from previous experience. The T. M. lehrs are, therefore, composed of units assembled side by side, relatively independent but when joined forming the length of the tunnel, each unit being able to achieve, in a perfect manner, its scheduled section of the temperature curve. Each unit is almost a closed ventilation circuit, since the ventilation is transverse to the flow of the glassware through the lehr and is equipped with instruments to control the temperature automatically, section by section. Thus, the glassware is subject to annealing treatment which conforms to the ideal, fixed time/temperature curve. The fact that the sections or units are independent, gives flexibility and mobility comparable with other modern production plants.

It is well-known that glassware, after passing through the critical temperature zones, when all strain has been removed, can be subjected to fairly rapid cooling. The T. M. lehr, however, takes account of the fact that the speed of cooling also depends upon the shape of the glassware and its composition and that in every case there exists a *point* on the annealing temperature curve where the cooling can be accelerated. The same principle of forced convection which is employed for conveying heat to the article is again employed for lowering the temperature of the article. This time by the application of cold or cool air. This section of the lehr or tunnel may be termed the "chilling section" and the rate at which the cold ventilating air can be applied is fully controlled and adjustable. Furthermore, drafts arising from currents of air which are always present in glassworks are nullified by this forced-air cooling system. Thus, by the time the glassware has reached the end of the chilling zone, its temperature has dropped to about room temperature and it arrives on the uncovered section of the conveyor belt, which forms the sorting table, in a condition suitable for handling.

The lehr is of all-metal-welded construction and is insulated with a 12-inch layer of rockwool, which, supported by insulating blocks, is interposed between the internal and external frames, thus preventing almost all heat leakage.

The absence of brickwork provides many advantages; there is freedom from leakage and breakage at expansion points, which normally follows successive heating and cooling, and thermal inertia is practically abolished.

The conveyor belt is of special metal trellis-work (woven mattress), and is driven by a rubber-covered drive-roller in such a way that the belt maintains contact over 300° of its circumference; an adjustable pressure roller ensures this degree of contact and alignment of the belt is obtained by the use of adjustable, swivel ball-bearings on both end-rollers. The belt is returned inside the lehr, so that the heat is retained. The inevitable initial lengthening of the belt is compensated by a weighted roller which, however, does not exercise any supplementary tension; the belt's passage through the lehr, therefore, is remarkably smooth. This system, together with the method of supporting the belt through the lehr, undoubtedly contributes to long belt-life.

The rubber-covered roller is driven by an electric motor through a planetary-type reduction unit and variable-speed control gear and this allows for easy variations of belt speed to be made from the normal ratio of 1:6 to as far as 1:100. These gear units are grouped together and enclosed in an oil bath. Continuous service without undue attention, except for periodic greasing can, therefore, be maintained.

Each heating section, or unit, is equipped with two fans, one under and the other over the lehr belt and under their impetus the lehr atmosphere is moved rapidly either in an upward or downward direction. One fan draws the air upwards through the belt, through the glassware being annealed and then through the heating

(*Continued on page* 658)

Technically Speaking . . .

(*Continued from page* 634)

temperatures obtained in our processes in order to apply more intelligently the information obtained in the laboratory. Methods were devised, some of them crude, for making such measurements in our factory operations and put together quite a bit of data. We were greatly surprised at the results. Temperatures of both glass and mold equipment in all the processes varied greatly and we could not understand how we were able to make bottles at all; but we were making millions of them; most of them were very good. We were anxious to determine just how well we could make a glass container if we could control things such as cycles, glass and mold temperature distribution, times of contact of glass and mold metal, the pressure imparted to the glass, etc. and determine their effects on the subsequent distribution of glass, on the number and type of defects produced and on the possible rates of production available.

With the results mentioned, an experimental machine was constructed. This machine, loaded with wires and recording devices, enabled a change of temperature, time, and pressure, at will, and the effects were recorded or noted. Cycles were studied and a new pilot machine designed and built to test further refinements. Improved distribution of glass in the mold during forming was being attained.

The next phase was construction of an experimental prototype of a commercial machine which took a year to build. It failed to turn out the perfect distribution of glass as each container had the same defect. Half way down the sides, in precisely the same place on every container, there was a bulge on opposite sides, and a noticeably thin section on the other areas. It was decided that the fault resulted from heat loss in the glass as it moved from furnace to machine. The machine was turned 90° in relation to the furnace and the defects moved with the machine. Obviously the problem was not one of delivery of glass from furnace to the machine unless it occurred just as the glass entered the mold. Direct feeding of glass to the mold removed the last mentioned effect as a possible cause.

It had been felt all along that the mold cooling conditions were absolutely uniform around the periphery of the mold. But a skeptical researcher noted that a small bolt used for holding the mold passed through the cooling air channel. He reasoned it might affect the desired uniformity. He removed the bolt and from then on the uniformity of glass distribution which we desired was a reality. It was only a matter of further mold cooling refinement and adjustment to attain the desired uniformity and distribution.

The mechanical bugs were worked out of the prototype and a 6-head machine was built and operated experimentally for the next three years. The machine makes wide mouth glass containers 20 per cent lighter, but still stronger, and much faster per mold than any other commercial machine of its size.

This cycle of development required about 12 years, but with the new facilities now available at the Technical Center we believe a similar job could now be done in three or four years.

A picture of the section prototype machine was on the cover of THE GLASS INDUSTRY for October, 1955.

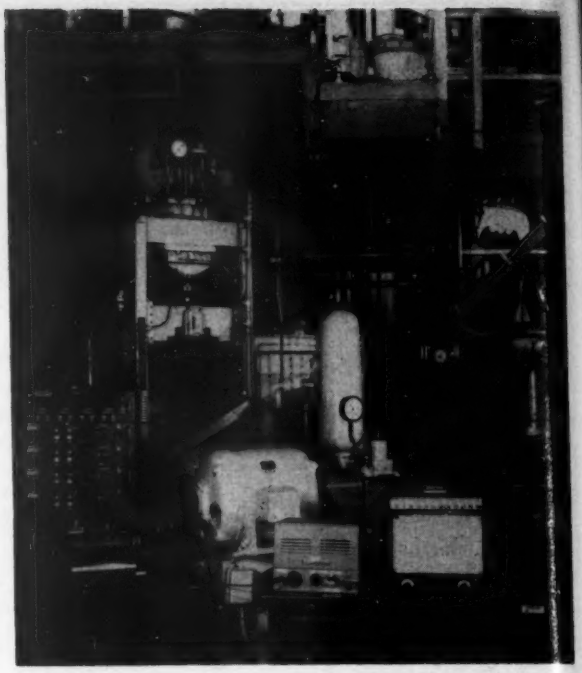


Fig. 16. The experimental press, together with all conceivable types of instrumentation, is used for work on heat transfer and other major problems of forming glass against metals.

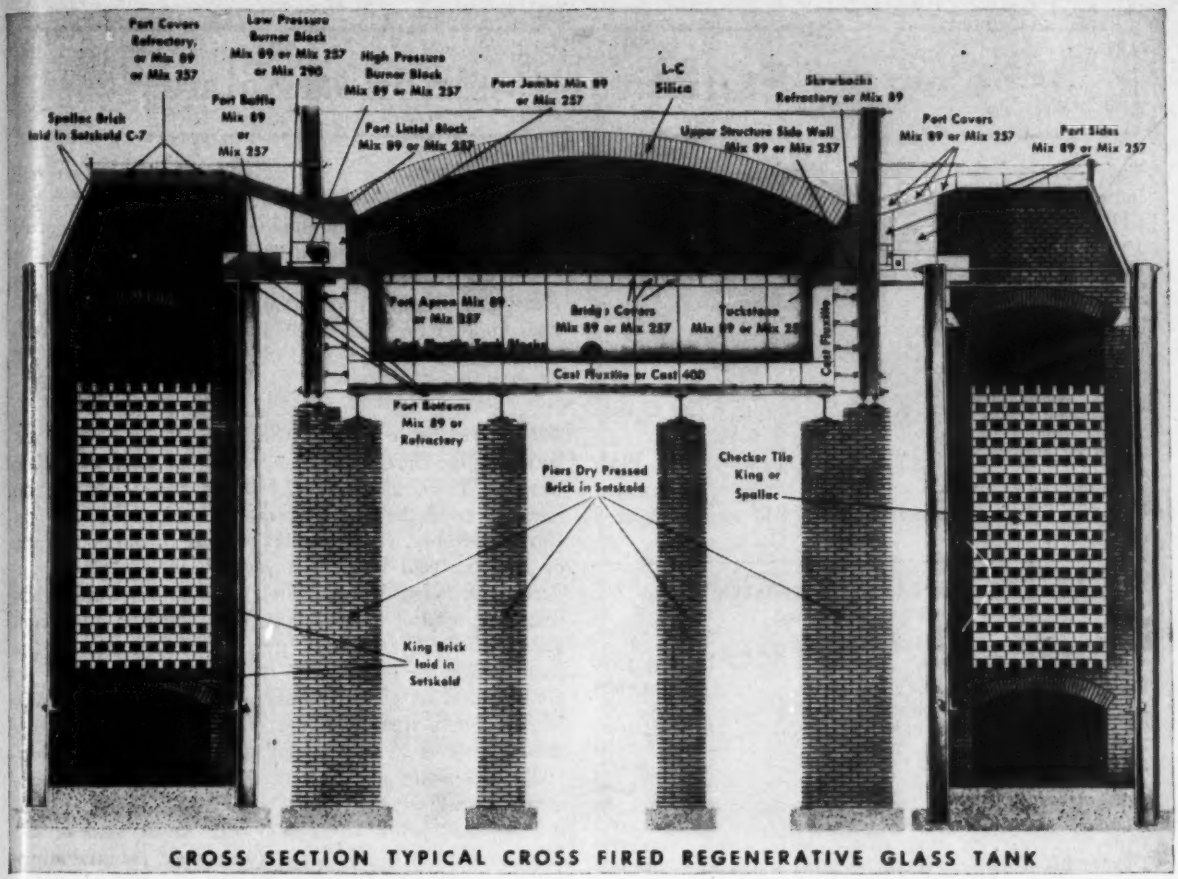
An interesting research tool used here for fact finding is the research testing press. The application of equipping an experimental machine with every type of instrumentation imaginable, has been carried even further in recent years. It was realized that a machine designed specifically for fact finding about what happens to glass and metals when they come together would be very useful. Since the maximum control is obtained in the pressing of a parison, we chose this type of unit. It represents the first and by far the most important stage in forming a wide mouth article.

The unit is known as a research testing press or experimental press. It has been designed for maximum flexibility as a fact-finding tool for experimental purposes only, Fig. 16.

Let us now tell you about some of the instrumentation which makes this a fact-finding quantitative unit as contrasted with only an observation unit. Built into the plunger holding head is a sensing device using strain gauges to measure the pull necessary to remove the plunger from the glass. A gob of glass is delivered to the mold and the plunger pressed in. Then as the plunger is pulled away from contact with the glass, this sensing device, together with an oscilloscope, measures the force. This is known as the plunger retraction force. A time scale is also imposed on the oscilloscope and so a build-up of force, plus the let-down can be plotted as a function of time. The oscilloscope record can be photographed. The resolution is such, that pulls of 5-10 pounds difference can be measured. The retraction from glass takes about 1/100 of a second and we can divide this into at least 20 different segments. A Sanborn recorder can also be used to record the force.

In addition, there are procedures for measuring the

(*Continued on page* 654)


Port Covers Refractory, or Mix 89 or Mix 257
Low Pressure Burner Block Mix 89 or Mix 257 or Mix 290
High Pressure Burner Block Mix 89 or Mix 257
Port Jambs Mix 89 or Mix 257
L-C Silica
Skewbacks Refractory or Mix 89
Spallac Brick laid in Setskold C-7
Port Baffle Mix 89 or Mix 257
Port Lintel Block Mix 89 or Mix 257
Upper Structure Side Wall Mix 89 or Mix 257
Port Covers Mix 89 or Mix 257
Port Sides Mix 89 or Mix 257
Port Aprons Mix 89 or Mix 257
Bridge Covers Mix 89 or Mix 257
Tuckstone Mix 89 or Mix 257
Cast Fluxite or Cast 400
Port Bottoms Mix 89 or Refractory
Piers Dry Pressed Brick in Setskold
Checker Tile King or Spallac
King Brick laid in Setskold

CROSS SECTION TYPICAL CROSS FIRED REGENERATIVE GLASS TANK

(All Refractory Mix 89 and Mix 257 laid in Setskold C-9)

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LACLEDE-CHRISTY COMPANY

DIVISION OF H. K. PORTER COMPANY, INC.
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Mission 7-2400

Current Statistical Position of Glass

Employment and payrolls: Employment in the glass industry during September, 1955, was as follows: *Flat Glass:* A preliminary figure of 29,900 for September, 1955, indicates a rise of only 2 per cent from the adjusted 29,300 reported for August, 1955. *Glass and Glassware, Pressed and Blown:* An increase of 5.3 per cent is shown by the preliminary 83,900 figure of September, 1955, when compared with 79,700 of the previous month. *Glass Products Made of Purchased Glass:* The preliminary figure at 15,000 indicates a rise of only 2.7 per cent from the previous month's 14,600.

Payrolls in the glass industry during September, 1955, were as follows: *Flat Glass:* An increase of 2.8 per cent is shown in the preliminary $14,727,843 when compared with August, 1955, adjusted $14,325,649. *Glass and Glassware, Pressed and Blown:* An increase of 5.9 per cent is shown in the preliminary $27,485,640 reported for September, 1955, when compared with the previous month's adjusted $25,961,478. *Glass Products Made of Purchased Glass:* A preliminary figure of $4,364,100 was reported for September, 1955. This is 3.4 per cent higher than the adjusted August, 1955, figure of $4,221,152.

GLASS CONTAINER SHIPMENTS
(All Figures in Gross)

	October, 1955
Narrow Neck Containers	
Foods	1,348,000
Medicinal & Health Supplies	1,350,000
Chemicals, Household & Industrial	823,000
Beverages, Returnable	352,000
Beverages, Non-returnable	59,000
Beer, Returnable	73,000
Beer, Non-returnable	524,000
Liquors	1,043,000
Wines	443,000
Toiletries & Cosmetics	864,000
Sub-total (Narrow)	6,879,000
Wide Mouth Containers	
Foods	*3,147,000
Dairy Products	240,000
Medicinal & Health Supplies	426,000
Chemicals, Household & Industrial	180,000
Toiletries & Cosmetics	151,000
Packers' Tumblers	124,000
Sub-total (Wide)	4,268,000
Total Domestic	11,147,000
Export Shipments	278,000
TOTAL SHIPMENTS	11,425,000

*This figure includes Fruit Jars and Jelly Glasses.

GLASS CONTAINER PRODUCTION AND INVENTORY
(All Figures in Gross)

		Production October 1955	Stocks October 1955
Foods; Medicinal & Health Supplies; Chemicals, Household & Industrial; Toiletries and Cosmetics	Narrow Neck	4,583,000	4,465,000
	Wide Mouth	*4,275,000	4,603,000
Dairy Products		277,000	319,000
Beverages, Returnable		421,000	1,200,000
Beverages, Non-returnable		67,000	241,000
Beer, returnable		110,000	304,000
Beer, Non-returnable		604,000	689,000
Liquors		1,252,000	1,266,000
Wines		452,000	455,000
Packers' Tumblers		132,000	177,000
TOTAL		12,173,000	13,719,000

*This figure includes Fruit Jars and Jelly Glasses.

Glass container production, based on figures released by the Bureau of Census, rose 8.3 per cent during October, 1955, to reach 12,173,000 gross. This is an increase over the previous month's 11,234,000 gross. During October, 1954, production was 10,843,000 gross, or 10.9 per cent below this year. Glass container production at the end of the first ten months of 1955 has reached a total of 115,538,000 gross, which is 8 per cent ahead of the 106,914,616 gross produced during the same period in 1954.

Shipments of glass containers during October, 1955, increased less than 0.04 per cent to reach 11,425,000 gross. This is a very slight increase over September, 1955, shipments which were 11,421,000 gross. Shipments during October, 1954, were 10,354,000 gross, or 9.4 per cent below October, 1955. At the end of the first ten months of 1955, glass container manufacturers have shipped a total of 113,523,000 gross, which is 8.8 per cent ahead of the 103,605,195 gross shipped during the corresponding period last year.

Stocks on hand at the end of October, 1955, were 13,719,000 gross. This is above September, 1955, stocks of 13,040,000 gross and 0.3 per cent higher than the 13,684,000 gross on hand at the end of October, 1954.

Automatic tumbler production during September, 1955, was 4,220,967 dozens. This is a drop of 29 per cent from August, 1955, production which was 5,931,118 dozens. Production during September, 1954, was 5,122,419 dozens. Shipments during September, 1955, dropped to reach 4,586,929 dozens. This is 18.5 per cent lower than August, 1955, 5,626,837 dozens. During September, 1954, shipments were 4,768,140 dozens. At the end of the 12-month period ending September, 1955, shipments have reached a total of 61,813,732 dozens, which is 1.6 per cent higher than the 60,819,995 dozens shipped last year.

Table, kitchen and household glassware: Manufacturers' sales of machine-made table, kitchen and household glassware during September, 1955, fell off 0.4 per cent to reach 3,406,369 dozens. This is a drop from August, 1955, 3,421,346 dozens. During September, 1954, sales were 3,503,309 dozens. At the end of the 12-month period ending September, 1955, manufacturers had sold a total of 37,835,335 dozens, which is above the 36,895,153 dozens sold during the corresponding 1954 period.

Electric Booster Melting . . .

(*Continued from page* 635)

Many different types of glass have been melted electrically now. They are: container flint, amber, green and blue; heat-resisting borosilicate, both clear and opal; lead crystal; lime crystal; white optical; high-iron optical; non-alkali; pharmaceutical neutral and heat-absorbing.

Uses

The technical uses for boosters have now been established. A booster will permit a tank to produce more glass at any period of time the operator chooses, requiring only to throw the switch on. A booster will permit a tank to operate at lower fire temperature while maintaining the same tonnage output. It will reduce the temperature gradient from top to bottom of the glass. It will reduce the loss of volatile components. (This is especially true in all-electric melting.) A booster will ease the firing problem if the ports, checkers, etc., are in bad shape. It will reduce the cost of refractories per ton of glass produced for the reason that the tank lasts just as many days, but produces more glass each day. In certain cases, such as small tanks and special glasses, boosting will out-compete fuel with respect to melting cost per ton. It will make batch charging easy in cases where there is freezing up in the doghouse. It will permit the use of less cullet, for the purpose of improving the color.

On the other hand, boosting won't cure bad batch mixing. It won't control the glass level. It won't remove tramp iron from the cullet. In other words, boosting can be a big help, but it is not a cure-all.

Cost of Installation

The cost of installing a booster can be given for average installations as $40-$50 per KW. Thus, a 300 KW installation to produce 15 tons more per day might cost $15,000. This includes all wiring, transformers, meters, electrodes, electrode installation, engineering, and paid-up license. It must be realized that there can be variations from these typical figures. One installation rented the necessary transformers and got by with $30 per KW. Another had extensive high-voltage wiring to do, added some experimental features, and came out with $90 per KW. Usually, extra tonnage can be obtained by boosting with only 1/3 the capital investment that would be required for a new furnace and building.

Cost of Operation

The power consumed per ton of container glass is under 480 KWH. Power cost in the industrial east averages 0.85 cents per KWH, giving a heat cost of about $4.10 per ton for the glass obtained by boosting. The refractory cost-per-ton saving mentioned above can be estimated at $1 per ton. The saving in interest on the saving in capital investment mentioned above is estimated at 30 cents per ton. Even after making these allowances, it can be seen that boosters would not ordinarily be put in to save on the heat cost per ton. Some other factor generally furnishes the basis for a decision.

Electrode consumption is generally low and is con-

(*Continued on page* 648)

Glass Laboratory Testing Scale

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Electric Booster Melting . . .

(*Continued from page* 647)

sidered normal at 8 cents per ton. The spread has been from 2 cents to 20 cents in favorable and unfavorable conditions, respectively.

Labor cost is low, since the only maintenance is to advance the electrodes occasionally. The time consumed is about an hour every 2-4 weeks.

Ease of Installation

This point is hard to generalize, since some installations are made cold while most are made hot. During the early days when we were first learning to drill tank blocks, especially Zac and Monofrax, while the tank was full of glass and operating, there wasn't anything easy about it from my point of view as the chief driller. However, we can say now that installation, hot or cold, is quite straightforward. On one job, a 600 KW booster was installed hot and was operating in 23 days total elapsed time, with no interruption of production.

Ease of Operation

Within my definition of a booster, nothing could be much simpler to operate. A daily check is made of the current in each electrode and once or twice a month the electrodes are adjusted. Ordinarily the only control is an on-off switch.

Reliability of Results

The first year of putting boosters in strange tanks furnished a few puzzles mixed in with the successes. A few tanks had to be re-worked to make them perform as promised. Solving these puzzles gave us a better understanding of how a booster does its work, and during the past year the results have been quite dependable.

Future Possibilities

The phrase, "current status of future possibilities," sounds like confused language, but it isn't, because the horizon for electric melting is changing as time goes on. Machines and lehrs are demonstrating their ability to handle more glass. While it is true that furnaces can be pushed also, progress in improving the melting rate by normal methods leaves something to be desired. Boosting, then, supplies a direct and positive method of increasing the tonnage output of a tank. It is quite possible that much of the normal-growth glass tonnage of this country will be obtained by boosting over the next ten years. The two main reasons are: flexibility, meaning the ability to get much more glass quickly at the will of management and the operator, without paying the penalty of low efficiency when the pull is low; lower capital investment per ton of increased capacity.

A very important by-product of electric-boosting work so far is the stimulation that it has given to the study of convection currents and the basic concepts of melting and fining. This investigation is not yet complete, but results demonstrated already indicate that we can expect, during the next few years, decisive improvements in our glass melting and preparation methods.

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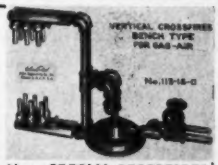

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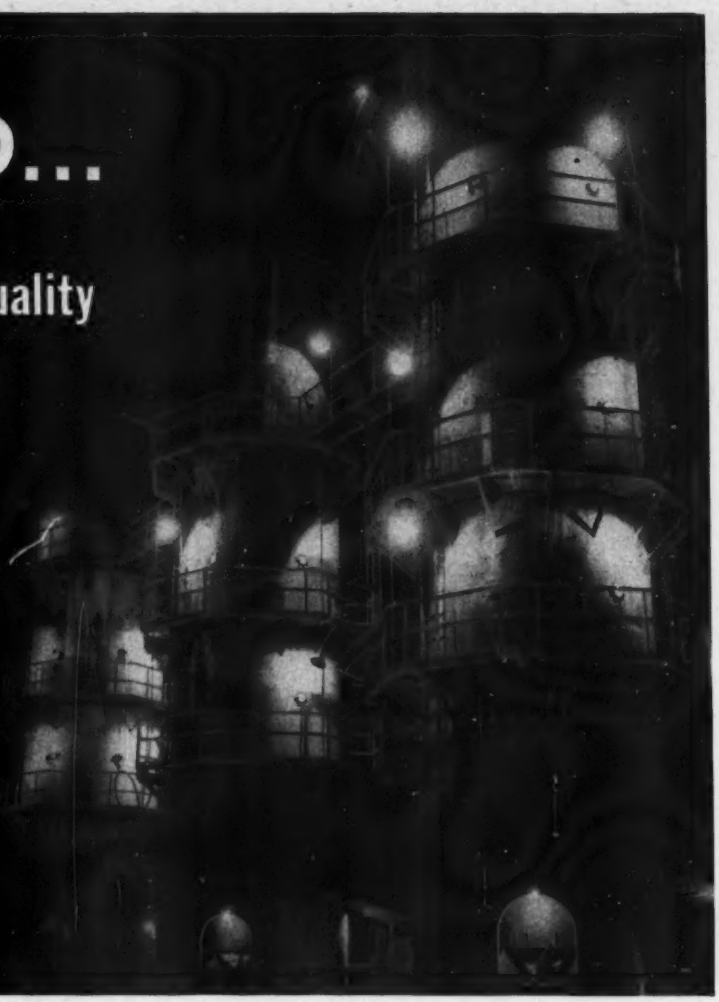

Giant kilns burn lime and coke to make carbon dioxide. This gas is used to separate the soda ash base from the brine that is pumped in from the natural deposits of Searles Lake in the California desert. The burned lime by-product is conveyed to a special plant where it is processed into hydrated lime—another product of West End Chemical Company.

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Practical Aspects of Seeds and Fining . . .

(*Continued from page* 637)

tests showed better meltability than a flint glass, yet was more difficult to melt in a production furnace than was the flint glass. If an obstruction such as a dam is placed in the furnace so as to cause convection currents to carry the green glass to the surface of the melter, highly beneficial results are observed in removing seeds.

A carbon-sulphur-iron amber glass presents more problems than either the colorless glass or the green glass. Breakdown of amber glass in the revolving pot of the Owens operation is not uncommon. The problems in connection with amber glass, however, are not confined entirely to the Owens operation. These same problems do exist with gravity feed operation, especially when ware being made is small; thus the production uses only a few tons of glass per day, but does require comparatively hot glass for the operation. Here the revolving tubes used in the process can produce turbulence and breakdown appears.

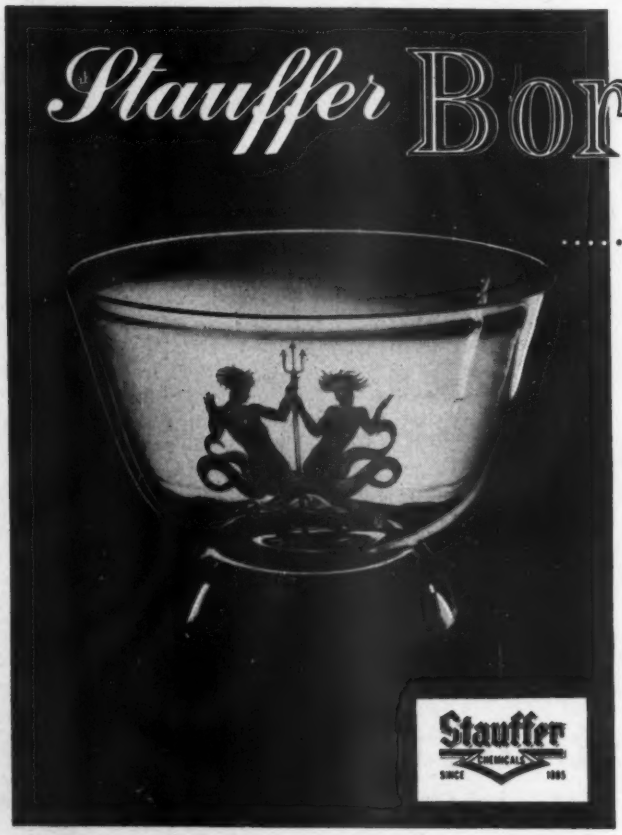
Previous to the time sulphates were added to the glass batch, as a batch material, we added sulphates to the batch as impurities in our normal glass batch materials, although the amount was small. Additional sulphates are introduced into the furnace from the fuels used and this can be an important source of sulphate. At the present time when using natural gas and low sulphur fuel oils it is not uncommon to find traces of sodium sulphates on the surface of the glass in the refiner. It is my guess that it is present on the surface of the glass in all refiners.

One instance of glass troubles is of considerable interest, namely, a car of barytes marked "heavy spar" was accidently unloaded into the feldspar bin. Approximately 12 hours later the amber glass showed breakdown in Owens operation, while the ware made on a furnace connected with gravity-fed operation did not show any increase in seed. It is natural to assume that there were equal quantities of gases present in the glass of both furnaces but that the agitation of the Owens operation caused seeds to appear there.

Again returning to earlier experiences of the hand gathering days, it was observed that when a sulphate-container alabaster glass was melted in a small tank, small blisters developed in the gathering area.

If opal glass is gathered at high temperatures, the opacity of the glass decreased rapidly, thus indicating the loss of fluorine. I do not recall that opal glass once melted can be reheated so as to cause reboil (normal furnace temperatures of 2500°-2600° F.). From the observation it appears that one glass, namely, opal glass, can be saturated with a gaseous substance or a substance which will liberate gas without causing seeds, whereas other glasses liberate gases which result in excessive seediness. Likewise, common salt can be added to the glass batch; a portion of this salt remains in the molten glass to come out in the refiner or in the revolving pot, or in the forehearth. However, the presence of salt in the glass tends to minimize the tendency for breakdown.

At this time questions can be raised as to the proper grain size of sulphate materials used in the glass batch; coarse grained materials used may not give us a thoroughly homogeneous glass melt. This thought can be



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followed through by observing a gob of hot glass taken from a gravity feeder and subjecting the hot gob of glass to a reduced pressure in a vacuum chamber. When such occurred, the gob of glass swelled up like a sponge and retained this condition when cooled under vacuum. All sizes of cavities appeared in this gob of glass, cavities ranging from 1/32 inch to 1 inch or more in diameter. This non-uniformity of voids further represents non-homogeneous glass, as well as something that liberates gases. When this same experiment is carried out on a gob of hot opal glass there was no swelling; in fact, only a very few blisters, approximately 1/8 inch in diameter appeared.

From these several observations, as mentioned, I desire to repeat my guess that sulphates, either as introduced into the batch as impurities, or as an intentional addition to the batch, or the sulphates formed in connection with furnace atmosphere constitute the major portion of our seedy glass problems. In amber glass we may have either undecomposed sulphates or sulphites causing our problem of seedy glass. Likewise, I will guess one of the factors causing the so-called reboil or the formation of blisters is brought about by fires and temperature on undecomposed sulphates or sulphites.

BOOK REVIEW

Proceedings of the Symposium on the Fining of Glass

The Union Scientifique Continentale du Verre is preparing the publication of a book on the proceedings of the Symposium on the Fining of Glass, held in Paris from June 21st to 23rd, 1955.

This volume will comprehend the "Survey on the Fining of Glass" prepared by the Deutsche Glastechnische Gesellschaft, all papers (over 30) presented at the sessions of the working groups, the reports written by the secretaries of the working groups on the essential facts discussed during their sessions, the discussion of these reports and the general conclusion drawn by Dr. Peyches, "general recording officer" of the Symposium.

The volume, in French, is scheduled to come out at the end of this year.

Additional information may be obtained from the Secretariat of Union Scientifique Continentale du Verre, 24, rue Dourlet, Charleroi, Belgium.

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Inventions and Inventors . . .

(*Continued from page* 641)

oscillatory movement in the path transverse to the direction of movement of the work. The upper tool of a pair may be moved to servicing position while the lower tool remains in position beneath the work to provide a support for the work, this being an important feature when the work consists of a thin and wide glass ribbon.

The patent contains four claims and the following references were cited: 1,474,672, Heuze, Nov. 20, 1923; 1,684,029, Howard, Sept. 11, 1928; 1,803,752, Ford, May 5, 1931; 2,176,481, Waldron et al., Oct. 17, 1939; 2,398,556, Pearson, Apr. 16, 1946; and 2,508,863. Labby et al., May 23, 1950.

Tube and Cane Machines

Machine for Sealing Metal Leads Through Glass Disc. Patent No. 2,718,095. Filed February 1, 1947. Issued September 20, 1955. Five sheets of drawings (none reproduced). Assigned to Sylvania Electric Products, Inc., by William Leroy Reiter, Stanley J. Gartner and Henry W. Roeber.

This invention relates to molding machines and more particularly to machines for sealing metal leads transversely through a glass plug, to form a header for radio tubes and like devices.

The illustrative embodiment includes a carrier for intermittently advancing multiple spindles successively past a series of loading stations, burners and press positions. Each spindle includes a two-cavity mold, the upper cavity of which is pivotally mounted for lateral shifting from the spindle axis to improve the accessibility of the lower mold. This facilitates the removal of the molded product and the loading of a new glass charge. Where metal inserts are to be loaded this accessibility is likewise an advantage.

The mold is rotated during the heating and pressing sequence. It is arrested and is so positioned with respect to the turret by a cam track cooperating with followers on each spindle so that another cam track, which laterally shifts the upper mold, will properly coact with its follower. These cam mechanisms also arrange the mold cavities so that their bores are in proper positions to receive the wires.

The glass stock is loaded into the bottom mold in the form of a ring or short tube prior to the insertion of the wires.

There were sixteen claims and nine references cited in this patent. 872,530, Meeker, Dec. 3, 1907; 1,640,442, De jong, Aug. 30, 1927; 2,058,880, Hunt, Oct. 27, 1936; 2,066,856, Rose, Jr., Jan. 5, 1937; 2,195,483, Franke, Apr. 2, 1940; 2,238,198, Weber, Apr. 15, 1941; 2,296,347, Hinkley et al., Sept. 22, 1942; 2,312,003, Schneider et al., Feb. 23, 1943; and 2,426,990, Ellefson, Sept. 9, 1947.

● American Potash & Chemical Corporation, manufacturer of natural sodium sulfate, has announced a 20 per cent increase in salt cake production. William J. F. Francis, western general sales manager, said the expansion was made primarily "to handle the continually-growing needs of the kraft paper and synthetic detergent industries."

Container ware manufacturers are becoming increasingly aware of the merits of B_2O_3 as a minor constituent. A primary source of supply is the Pacific Coast Borax Co. with its continuous record of supplying highest quality boron compounds for more than fifty years. One single organization—from mine to refined product—assures top grade.

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Technically Speaking . . .

(*Continued from page 644*)

plunger displacement (location) as the retraction occurs. A differential transformer measures the shape of a total curve of plunger displacement totalling .015 inches. Rates can be measured.

Another scheme uses a slide wire as one part of a potentiometric circuit, with the slide contacting the wire mounted on the plunger mechanism. This will give a precise measurement of glass contact time and the slowing up of the plunger as it enters the glass. Any chattering or back-slap is also evident.

Mold temperatures, measured by the Glass Technology and Process Development groups, are measured by suitable thermocouples whose junction is basically made a part of the surface, or of a plane a few thousandths behind the surface (see Fig. 12). This is a complicated technique which was evolved over many years of experience. It is not simple, but the problem lies in orienting the junction in a definite plane at a known distance behind the surface. Then there are heat compensating schemes to keep the couple wire from carrying too much heat from the junction. Technique of thermocouple measurement always involves a certain depth of immersion of the measuring junction into the medium of constant temperature. Here, however, no constant temperature volume is available, so special techniques are necessary. By these techniques we put several thermocouples into one mold, at different positions and depths, and we plot gradients, both as to position and depth. Gradients can generally be interpreted to rates and so the story is built up. Preheated contact pyrometers are also specially built for measuring surface temperatures. A Sanborn 4-channel recorder gives a record without too much lag. Ordinary recorders do not follow the output fast enough.

Glass temperatures are measured at different depths and positions by placing the couple into position before press and letting it be pressed into the glass. Afterwards the position is carefully measured, as this is a procedure which does not allow exact placement. The same scheme was used 15 years ago in the early glass temperature work referred to above. Sometimes the thermocouple is preheated to lessen its lag of measurement.

This is a brief description of some of the things we measure during glass fabrication. Studies have related metal surfaces, coatings, checking of glasses, etc., all to other specific variables. Instrumentation and measurement are the keys we use here.

Product Research

In the Product and Supplemental Process Research & Development group we have a team working on developmental phases necessary for the introduction of a new product to the market. This group takes the more or less standard established products and processes and evaluates supplemental processing necessary for a new product, or a whole new regime of processes may result in a new product. This work necessitates an extensive knowledge of the limitations of the present processes as well as a visualization of totally new products.

Starts may be made on the specifications for the new product or such specification may come from potential customers. They are likely to grow and refine as the development proceeds. We must develop the sequence of operations necessary for the final product. Some of these steps may fall into the category of our own processing and some may fall into the group of processes our customer must use in his factory.

A good example of the teamwork is the research on color television bulbs. Here we developed a "solder glass" used to seal the funnel and faceplate of a color television bulb. Almost all color TV systems, unlike black and white, require that the bulb be separable at or near its largest diameter without the application of high temperatures. This is required so that the working parts, which are of large size, can be installed and removed for repair without destroying the bulb. The solder sealed bulb meets all these requirements. The solder glass is used as a joiner after we apply it to the edges of the faceplate and funnel. We provide solder glass, applied on the carefully contoured and flat edges of two glass parts. The solder glass is applied by dipping the prepared edges of the parts in molten solder glass.

After the customer inserts the color assembly into the glass parts, he will make his solder glass seal by following complete processing specifications worked out by Owens-Illinois and supplied as a part of the process. In addition, disassembly instructions and equipment are also supplied in case the tube proves to have defective internal parts. The glass parts are reusable.

The Future

What does this new Technical Center mean to Owens-Illinois and to the glass industry in general? In the first place, it means that the research and development will enter an era where the pace is quickened. It means that all possible new uses and products for glass will be scanned today for tomorrow's usage. The physical facilities stand as a visible indication of our determination to search for answers for the future. The outlook was aptly stated by Mr. Megowen, president of Owens-Illinois, at the dedication when he said: "When we contemplate the technical changes of the future as they relate to business we might summarize and say that everything that we eat, wear or otherwise use today is either obsolete or is threatened with obsolescence now. Every process of manufacture in use today is similarly obsolete or threatened with obsolescence. Coupled with our anticipation of high industrial activity in the future comes also a great feeling of uncertainty as to the particular products and services that will be required. Industry must help to create the future products and services in the markets of tomorrow. A particular industry must help to create these markets with new and better products and processes if that particular industry hopes to remain successful."

LEONARD FARMER JOINS O-I

Leonard H. Farmer, Jr., has resigned his partnership with the Toledo law firm of Fuller, Harrington, Seney & Henry, to join the Legal Department of Owens-Illinois Glass Company.

Mr. Farmer will serve as counsel for Kimble Glass Company and Toledo Automatic Brush Machine Company, both O-I subsidiaries and for the Central Purchasing and Real Estate departments of the parent firm. He will succeed Max C. Powell, who is to be assigned to Owens-Illinois' foreign operations.

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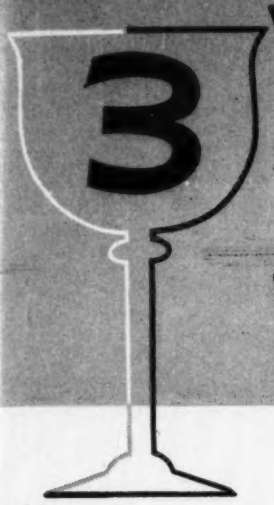

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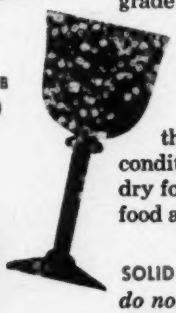

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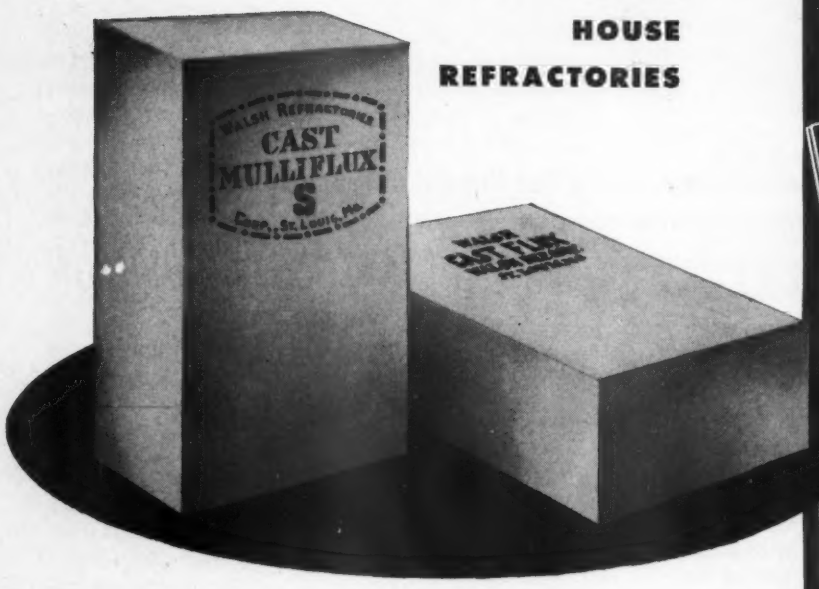

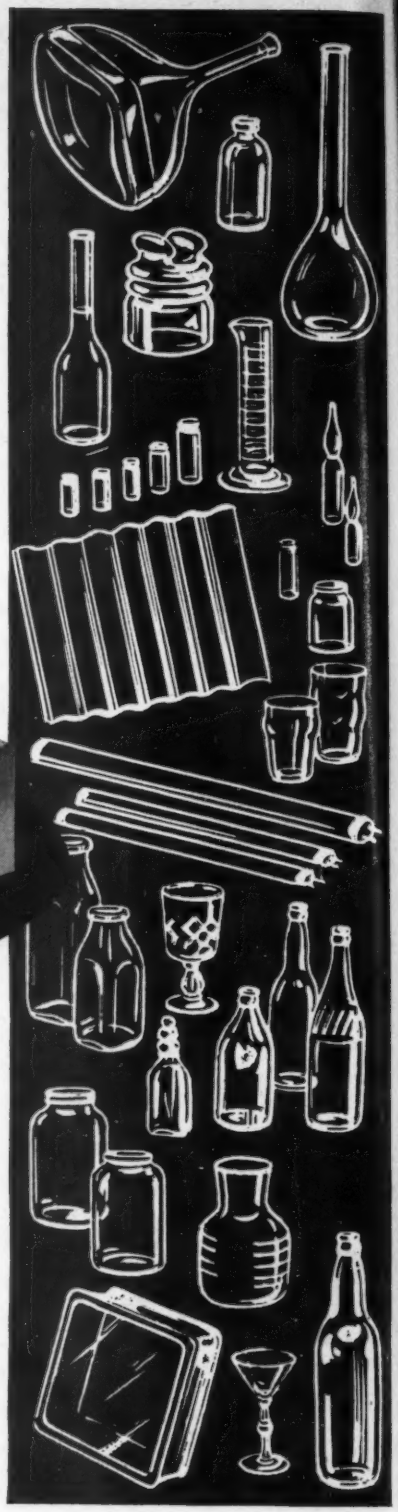

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West Coast Meeting . . .

(*Continued from page* 636)

was in progress at that time in regard to positioning the electrodes and in increasing the tank size until they reached 25 tons. In 1950 a second tank was put into operation following which flint glass as well as amber was produced. Since 1950 both units have been changed over to use molybdenum electrodes and booster melting was applied to the larger oil fired tank.

Even though good quality glass is being produced in both units, development work is continuing. The glass is consistently of good quality in respect to cords, stones and seed; maintenance is reduced to a minimum and tank life is extended. These factors are of interest to all glass manufacturers, particularly the statement that with booster melting extended, pulls of 3.88 square feet per ton have been experienced at bridge-wall temperatures of 2700°F.

Mr. Campbell then introduced Ragnar Hanssen, owner of the Moss Glaswork of Moss, Norway. Mr. Hanssen stated that there are four glass producing plants in Norway, but the Moss plant manufactures the bulk of that country's glass containers. Due to a shortage of both oil and coal in 1939 it was necessary for them to resort to electricity as the source for fuel. It was a drastic change-over but the project turned out to be satisfactory and economical. About 1946 their melting unit was rebuilt along the San Gobain pattern, using the electric pre-melting tank. Mr. Hanssen further described in considerable detail other phases of their operation.

MAXWELL J. JONES ELECTED PRESIDENT OF OBEAR NESTER GLASS COMPANY

Maxwell J. Jones was elected president and treasurer of the Obear-Nester Glass Company at a recent meeting of the Company's board of directors held in St. Louis, Missouri. Mr. Jones succeeds the late Joseph M. Nester who died on August 22, 1955.

Associated with Obear-Nester for the past twenty-nine years, Mr. Jones has served as executive vice-president and as a member of the company's board of directors.

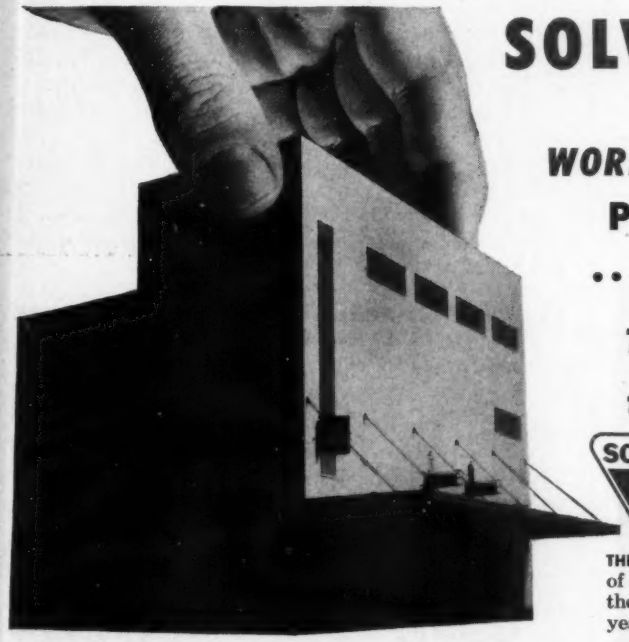
Mr. Joseph K. Nester will remain chairman of the board and Mr. William A. Nester and Mr. Michael P. Nester have been re-elected vice presidents. Mr. Leonard E. Sheppard was re-elected secretary.

New officers elected were Nathan G. Fletcher, vice president in charge of plant operations and Mark A. Maley, vice president in charge of sales.

WHITE CAP ACQUIRED BY CONTINENTAL CAN

Acquisition of White Cap Company of Chicago, Ill., manufacturer of vacuum-sealed closures, by Continental Can Company, Inc., has been approved by the director of both companies and will become effective upon completion of routine formalities, it was announced November 4th.

The announcement, made jointly by General Lucius D. Clay, Chairman of the board of Continental and Mr. George P. White, chairman of the board of White Cap, stated that the business of White Cap Company, which will become a subsidiary of Continental, would be carried on unchanged by the present White management.



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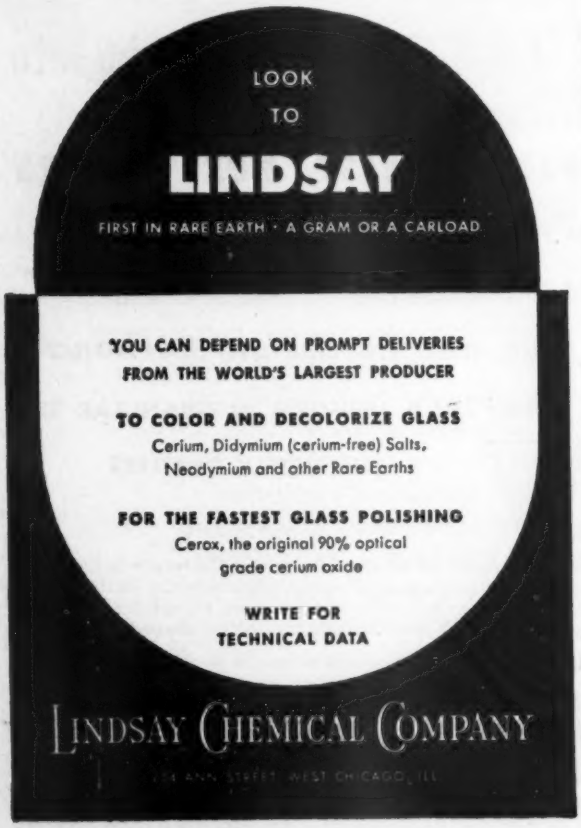


Research Digest . . .

(*Continued from page* 643)

element, which is situated at the top of the lehr, immediately before the fan intake. The air is then exhausted to the second half of the unit, through a second heating element and thence in a downward direction through the glassware and the belt to the second fan, which is located under the belt in the second half of the unit. This fan picks up the air and exhausts it to the first half of the unit, thus causing a circulation of air in an almost closed circuit. The temperature is maintained by the two heating elements and thermocouples, located in these circuits, are used for measuring and control purposes. Bare thermocouples are used to minimize inertia, but they are so situated that they are protected from any heat radiation from the glassware or from the heating elements. The direction of circulation is inverted every thirty inches along the length of the heating section.

The fans and the electric heating units or elements are replaceable during the working of the lehr.

In the rapid cooling section a large centrifugal fan blows cool air through ducting, which distributes the air with great uniformity, the quantity being regulated by inlet dampers; the regulation provided by these dampers, in relation to the outlet, can provide any required degree of pressure in this section of the lehr, thus ensuring freedom from drafts.

Actual performance has shown that 14 inch conical television tubes can be annealed in 45 minutes, heavy bottles can be annealed in about the same time and tableware of the normal type is annealed in times varying between 30 and 50 minutes. For decorating purposes the bottles take normally 105 minutes, the bottles, of course, entering cold and leaving again in the same condition. Examples of hourly power consumption (including energy for driving the fans) are as follows:

Normal hollow tableware, production from 12 holes, 30 KWH.

Bottles, automatic production of 20 tons/24 hours, 9-12 KWH.

Glass bricks, production of 20 tons/24 hours, 30 KWH.

Decoration of bottles, 35,000 1/3 liter bottles/24 hours, 105 KWH.

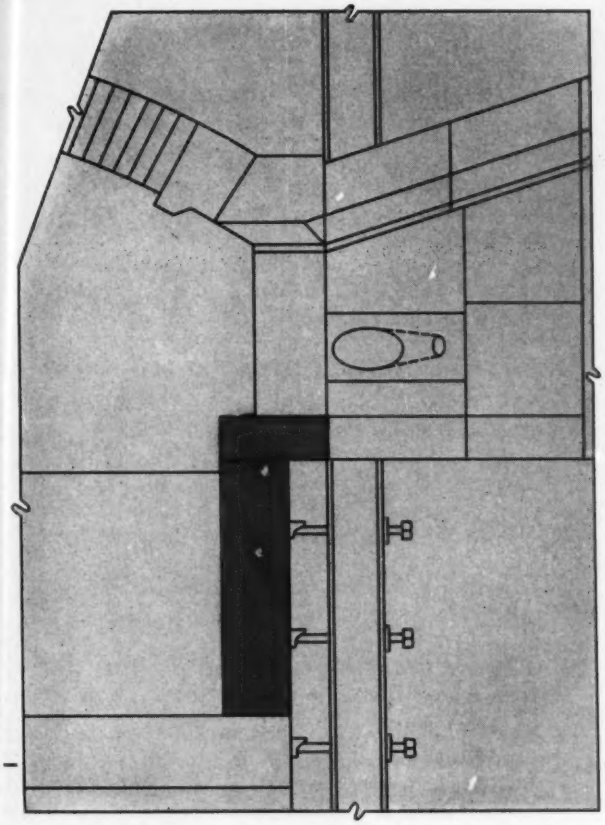
SYMBOL FOR BRITISH HAND MADE CRYSTAL GLASSWARE

As of October 1, 1955, those members of the Glass Manufacturers' Federation manufacturing hand made crystal glassware have collectively adopted a symbol both to denote their similarity of interest and to focus attention on their products.

The symbol shows the British Lion Rampant in the act of blowing, holding between his forepaws a blowing iron, the traditional tool with which hand made crystal glassware is made. The whole is encircled by the words "G.M.F. British Hand Made Crystal."

This might be a good idea for American manufacturers of hand-made ware, who are members of the American Glassware Association to think about.

How to assure better protection *in* TANK WALLS *and* TUCK STONES



TANK WALLS. Installed in melting and refining end side walls, Monofrax® M fused cast blocks are highly resistant to even the most corrosive glasses. Their dense, tightly-locked crystalline structure sees to that . . . and prevents upward drilling as well. They consist of over 98% alpha and beta alumina, with less than 0.2% impurities and with practically no interstitial glass. Purity of M exceeds that of any other commercial glass house refractory.

TUCK STONES. Monofrax® H tucks, made of a one phase material, do not tend to spall or flake into the molten bath. Their 99% beta alumina content provides essential resistance to the cutting action of impinging flame, heat shock and volatile attack. Interstitial glass is less than 0.05%.

High alumina, purity and absence of interstitial glass combine in Monofrax® refractories to insure maximum life with a minimum of refractory-caused problems. Carefully made to close tolerances, these blocks give tight-fitting, more durable structures.

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the trend is to **MONOFRAX®** **FUSED CAST** *refractories*

FLINT TO RECEIVE TOLEDO GLASS AND CERAMIC AWARD

The first presentation of the Toledo Glass and Ceramic Award, established by the Northwestern Ohio Section of the American Ceramic Society, will be made to Francis C. Flint, technical director of the Hazel-Atlas Glass Company, Wheeling, W. Va., at a banquet in the Commodore Perry hotel, Toledo, on January 20, 1956.

The award has been voted to Mr. Flint as one of the most active members of the Glass Division of the ACS, as the organizer and chairman of the first Gordon Conference in the field of glass and because of his personal contribution to communication between glass technologists and the encouragement and stimulation of younger scientists and engineers in the field of glass technology.

Mr. Flint will make a special address at the award banquet in Toledo in accepting the honor.

The Award Committee has established that the tangible expression of the honor will be in the form of a lead glass vase about 11 inches in height to be made by craftsmen of the United States Glass Company, Tiffin, Ohio, with the design being prepared by Edwin D. Fuerst, Waterville, Ohio, with Blake-More Godwin, director of the Toledo Museum of Art, as consultant.

A native of Chicago, Francis C. Flint, born November 29, 1890, received his high school education at Long Beach, California and his bachelor of science degree from Pomona College in 1915. The following year he was a graduate student at the University of California, then returned to Pomona College as instructor and later became a chemist with E. I. duPont de Nemours & Co., Inc. From 1919 to the present he has been associated with the Hazel-Atlas Glass Company and for many years has served as its technical director.

He is a Fellow of the American Ceramic Society and served as its president in 1936. He is an honorary Fellow of the Society of Glass Technology (British), and was its American treasurer from 1926 to 1953. In addition. he is a member of the American Chemical Society and the American Institute of Chemical Engineers.

Nominations for the Toledo award were received from 11 states and Canada and under the terms of the award will remain on file and be considered for three years. Further nominations for the second award will be received next summer.

The primary purpose of the award is "to accord recognition for a scientific or engineering achievement, but the award is not limited to such achievements," the announcement revealed. Achievement is to be interpreted in a broad fashion, it was said. There are no requirements as to time, place, duration, or type of work or contribution to the glass and other ceramic industries.

No monetary award is considered as a part of the Toledo Glass and Ceramic Award. The glass vase has been selected as a memento of prestige and permanent value.

Members of the Award committee include Larry V. Gagin, of L.O.F Glass Fibers Company, chairman; Fred L. Bishop, J. C. Coleman and Oscar G. Burch, of Owens-Illinois Glass Company; Harold A. McMaster, of Permaglas, Inc.; Ralph Day, of Libbey-Owens-Ford Glass Company and K. C. Carnes, of Toledo Engineering Company. H. H. Holscher, of Owens-Illinois Glass Company, is chairman of the Award Finance Committee. V. W. Frederick, of Libbey-Owens-Ford Glass Company, Rossford plant, is chairman of the Arrangements committee. Reservations for the banquet to honor Mr. Flint may be made through Mr. Frederick at Rossford, Ohio.

WILLARD P. SCOTT APPOINTED VICE PRES. OF AMERICAN POTASH & CHEMICAL

Willard P. Scott, a director of American Potash and Chemical Corporation since 1951, has been appointed a vice president of the company, it was announced by Peter Colefax, president.

Scott will remain a partner of the New York law firm of Oliver & Donnally, who are general counsel for American Potash & Chemical Corporation.

WYANDOTTE CEMICALS NAMES MUNCHMEYER

Bert Cremers, vice president and general manager of the Michigan Alkali Division, Wyandotte Chemicals Corporation announced the appointment of Louis W. Munchmeyer as assistant general manager.

Mr. Munchmeyer's background includes 15 years service with E. I. du Pont de Nemours Company, Inc., he is a former vice president of the Michigan Chemical Corporation and comes to Wyandotte from the Ansco Division of General Aniline and Film Corporation.

LEE WATERMAN ELECTED VICE PRESIDENT OF CORNING GLASS WORKS OF CANADA LTD.

R. Lee Waterman was elected vice president of Corning Glass Works of Canada Ltd. at a meeting of the board of directors in Corning. He was also elected a director of this Canadian subsidiary of Corning Glass Works, filling the vacancy created by the death of Glen W. Cole.

Mr. Waterman recently joined Corning Glass Works as general manager of the Consumer Products Division.

MERGER OF CONSOLIDATED CHEMICAL INTO STAUFFER CHEMICAL APPROVED

The merger of Consolidated Chemical Industries into Stauffer Chemical Company was approved by stockholders of both companies at special meetings held November 14 in San Francisco.

At the Stauffer meeting 2,204,499 shares or .93 per cent of total shares outstanding, voted in favor of the merger, with 390 shares voting no. At the Consolidated meeting, 223,013 shares of the Class A stock, or 83 per cent of the total shares of such stock outstanding, voted in favor of the merger, with 2,985 shares voting no.

It is expected that the merger will become effective on November 14, 1955, and after the merger, the total assets of Stauffer Chemical Company, the surviving corporation, will be $125,000,000.

In the bottle washer, container labels are subjected to high temperatures and strong alkali solutions.

For excellent alkali resistance—use Du Pont Glass Colors

Washing with strong alkali and repeated sterilization can shorten the life of ordinary glass container labels, but not labels of Du Pont Glass Colors!

Durable Du Pont Colors withstand acids, alkali and continual sterilization. The smooth, even coats they produce are stable over a wide firing range . . . assure maximum coverage. Careful testing of each color before shipment assures you of uniformity and high quality.

Depend on Du Pont for a complete line of glass and ceramic colors: overglaze and underglaze, body, slip, glaze stains and squeegee oil. For complete information write E. I. du Pont de Nemours & Co. (Inc.), Electrochemicals Department, Wilmington 98, Delaware.

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Season's Greetings
Our sincerest wishes for a HAPPY YULTIDE season ... laden with love, warm friendship and good fellowship.
May the spirit of peace on earth to men of good will prevail during the coming YEAR
... and may health and prosperity be yours.
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Los Angeles, California

LACLEDE-CHRISTY APPOINTMENTS

Edward F. Jennings has been appointed New York district sales manager for Laclede-Christy Company, Division, H. K. Porter Company, Inc.

In addition to his new position as New York district sales manager, Mr. Jennings will continue to supervise Export Sales.

Also announced was the appointment of Andrew M. Coventry as credit manager for the Laclede-Christy Division. Mr. Coventry will supervise accounts receivable, credits, collections and credit policies and procedures.

Previously, he was general credit manager for Magic Chef, Inc., St. Louis, Mo.

BROCKWAY GLASS ACQUIRES DEMUTH GLASS WORKS, INC.

C. A. Mengle, president of the Brockway Glass Company, Inc., announces that satisfactory negotiations have been completed for the acquisition of the Demuth Glass Works, Inc.

Properties of Demuth are located at Parkersburg, West Virginia and production is devoted to the manufacturing of glass tubing used in fabricating homeopathic vials and kindred items for the pharmaceutical trade. Glass tubing is also used in the manufacture of electronic equipment, as well as electric light bulbs.

In addition to making tubing, Brockway will process an entirely different texture of glass for further diversification from the general line of containers that they are now manufacturing.

Mr. Mengle states that this is Brockway's first forward step in the company's long range plan of diversification and that it will require an expenditure of from $1,000,000 to $1,500,000 for the company's contemplated improvements and expansion program.

There will be no important changes in personnel, nor will there be any interruption in the present operations.

NEW DOW SODA ASH PLANT

The Dow Chemical Company announces that commercial production of soda ash has started at its new $3,000,000 Texas Division plant at Freeport. Its capacity has been announced as 300 tons daily.

Donald Williams, vice president and director of sales, said the facilities establish Dow's entry into a major new alkali market, complementing the company's production of caustic soda.

The plant utilizes Dow's own process, differing markedly from the process which has been used for years. Development of the new process reflects the company's long-range research program, which started in 1945. Final research, engineering, construction and production start-up phases, however, moved rapidly and were covered in less than three years.

Donald Williams, vice president and director of sales, announced that the material in granular crystal form, will be shipped either in bulk or in 100-pound bags.

● Vince Young of the Bausch and Lomb Optical Company of Rochester was elected president of the Ceramic Association of New York at the 22nd annual meeting of the association held at Alfred University. He succeeds R. E. Daniels, outgoing president. Mr. Daniels is president of Airseal Insulations, Inc., Buffalo.

JAMES E. CASTLE APPOINTED MANAGER AT INTERNATIONAL MINERALS

James E. Castle has been appointed manager of the Industrial Minerals Division of International Minerals & Chemical Corporation, it was announced by Norman J. Dunbeck, vice president in charge of the division.

Mr. Castle, who will headquarter at the corporation's main offices in Chicago, has had extensive mining experience in this country and abroad. He comes to International from Foote Mineral Company, where he was plant manager at Kings Mountain, N. C.

TOLEDO ENGINEERING APPOINTS NEW OFFICERS

Charles W. Batchell, president of the Toledo Engineering Company, Inc., recently announced the appointment of the following officers:

K. C. Carnes has been named vice president, L. W. Dittlebeck, assistant secretary and F. M. Merritt, chief engineer.

Mr. Carnes and Mr. Dittlebeck have been with the company for nineteen years and Mr. Merritt has been connected with the firm for fourteen years. Each of these officers previously held a responsible position with the company.

TYLER G. PETT JOINS KOPP GLASS

Kopp Glass, Inc. has announced the addition of Tyler G. Pett to its Technical staff. He had been associated with Bausch & Lomb Optical Company as head of the Glass Physics Section of the Chemical Research Laboratory.

Mr. Pett will specialize in problems of glass structures in relation to physical and chemical properties. These studies are basic to the improvement of lenses and color filters used to control and modify beams of light.

FRANKLIN B. POLLOCK ELECTED PRESIDENT OF THATCHER GLASS

At the meeting of the board of directors of Thatcher Glass Manufacturing Company, Inc., held at Ithaca, New York, October 29, the resignation of F. K. Rodewald as president of the company was accepted by the board and Franklin B. Pollock was elected president and retains his position as chairman of the board of directors. Mr. Rodewald will retire from the company but will remain a member of the board of directors.

● The Pittsburgh Corning Corporation has appointed Walter Lovett as manager of the newly created Technical Service Department.

OVERMYER EMPLOYEE RECEIVES NAM AWARD

The 54th annual meeting of the Indiana Manufacturers Association was a significant occasion for Harold Martin, apprentice mold maker at the Overmyer Mould Company. The meeting was held October 25 in Indianapolis and was attended by over 400 manufacturers from Indiana.

Each year an award is made to one apprentice in the state of Indiana for the most outstanding apprentice of the year. Selection is made on the basis of skill, technical knowledge and individual efforts towards advancing the craft.

The 1955 award was made by IMA president, Edward R. Westphal to Harold Martin who is a fourth year apprentice at Overmyer Mould. Mr. Martin recently completed related instruction in the Winchester School system which was arranged through the Indiana Department of Public Instruction by OMCO. Martin's participation in this program and his standing as a fourth year apprentice qualified him to be among the apprentices eligible to receive the IMA award. Final selection was made by the Indiana Department of Public Instruction, Federal Bureau of Apprenticeship, Department of Labor and officials of Overmyer Mould Company.

E. R. Flatter, vice president of the mold firm, stated that "the award reflects the character of the individual, his union and the company. It is the objective of Overmyer Mould Company to conduct apprentice training programs that will create workmen of the highest skill and build an organization capable of meeting the needs of the growing glass industry."

THE SHARP-SCHURTZ COMPANY

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When you use *Cullet*, your batch will melt at a much lower temperature and will

PROLONG THE LIFE OF YOUR TANK

Quality Cullet Since 1900

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R. A. HEINDL RETIRES FROM NBS

Raymond A. Heindl, chief of the Refractories Section of the National Bureau of Standards and an internationally known ceramist retired after 32 years of service.

Mr. Heindl came to the Bureau in 1923, as a member of the Refractories Section of the Mineral Products Division and in 1927 became section chief, a position he held until his retirement. His research has been basic to improving refractories and has contributed to many Federal Government and American Society for Testing Materials (ASTM) Specifications.

NEW APPOINTMENTS AT L.O.F GLASS FIBERS

Creation of a new Market Research Department and appointment of a department manager were announced by J. M. Johns, vice president and director of sales of L.O.F Glass Fibers Company.

Heading the department will be Norman F. Heydinger, who will be responsible for analyzing the market for a wide range of glass fiber products manufactured by the company.

Creation of a Combined Customer Service Department was also announced by Mr. Johns, and Raymond Petersen was named its manager.

The new department combines the service facilities of the General Products and Textile division of the firm.

Richard E. Damm has been appointed credit manager of the L.O.F Glass Fibers Company, it was announced by F. H. May, Jr., vice president, secretary and treasurer.

Mr. Damm was credit manager of Kasco Mills Division of Corn Products Sales Company. Prior to that, he was with the sales order department of Libbey-Owens-Ford Glass Company.

● Jack E. Irwin of the Brockway Glass Company has assumed duties as district manager of the company's Cleveland office.

● A. F. Franz was re-elected as president of The Colorado Fuel and Iron Corporation at a special meeting of the company's board of directors.

"HOW FAR THAT LITTLE CANDLE THROWS HIS BEAMS!"
Merchant of Venice
The glow of the Christmas candle — symbol of love and caring — of warm shelter and gentle hearts. Symbol, too, that tiny flame, of all the material things that, not only at Christmas but at every other time as well, feed you, house you, clothe you, transport you, entertain you, protect you. All have their origin in flame — the flames of industry — contained by refractory brick.
GENERAL REFRACTORIES COMPANY, Philadelphia 2, Pa.
A COMPLETE REFRACTORIES SERVICE

Milestones in Glass Progress

PHOTO COURTESY THE METROPOLITAN MUSEUM OF ART

1560 (A. D.) The Romans were the first to manufacture glass for use in windows. But their glass was thick, and available only in small pieces. It remained for Byzantine workers, during the Dark Ages, to develop the artistic use of color. Shown is a 16th century result of these developments—an ornate, stained and enameled panel made in Switzerland.

1890 Michigan Alkali Company, now a division of Wyandotte Chemicals Corporation (South Plant, above), was founded by Captain J. B. Ford to supply Soda Ash to the glass industry. Wyandotte has grown up with glass. Today, as in the past, it is a working partner, supplying technical assistance and raw-material chemicals to those great companies marking milestones in glass progress.

Wyandotte

REG. U. S. PAT. OFF.

CHEMICALS

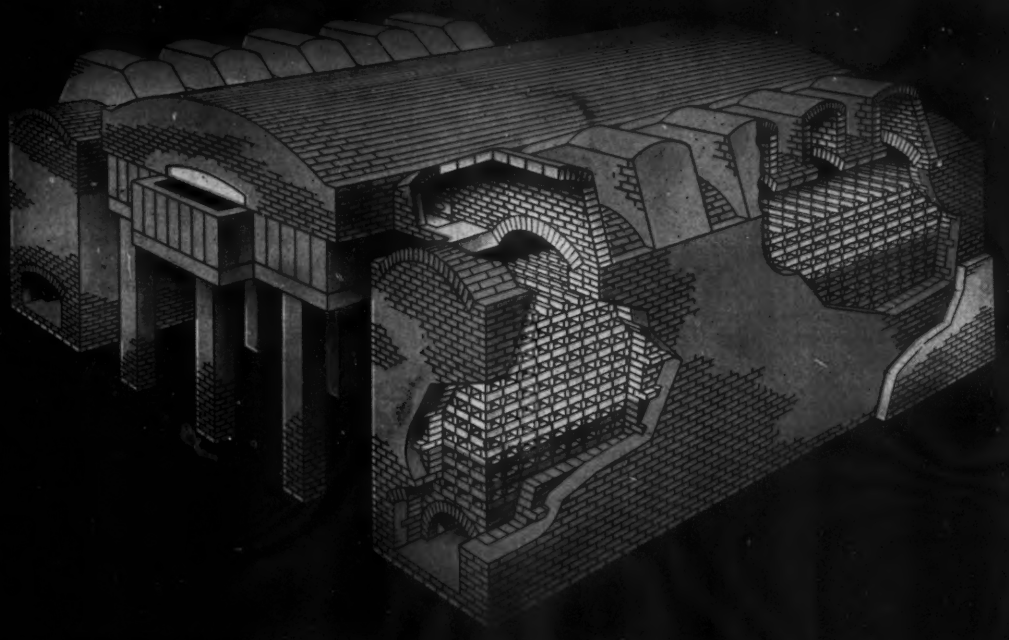
Wyandotte Chemicals Corporation, Wyandotte, Michigan
Offices in Principal Cities

Founded by a Glassmaker to Serve the Glass Industry

INDEX TO ADVERTISERS

	Page
American Potash & Chemical Corp.	617
Babcock and Wilcox Company	667
Bassichis Company, The	664
Cambridge Wire Cloth Company	620
Carborundum Company, The	659
Colorado Fuel & Iron Corp., Wickwire Spencer Steel Division	616
Columbia-Southern Chemical Corp.	626
Corhart Refractories Company	613
Diamond Alkali Company	618
Dominion Minerals Division Riverton Lime and Stone Co., Inc.	651
Drakenfield & Co., Inc., B. F.	619
du Pont de Nemours & Co., Inc., E. I.	661
Eisler Engineering Company	648
Exact Weight Scales	647
Frazier-Simplex, Inc.	611
General Refractories Company	665
Harshaw Chemical Company, The	Cover II
Hommel Company, The O.	662
Kahle Engineering Company	658
Kaiser Aluminum & Chemical Sales, Inc.	622 & 623
Laclede-Christy Company	645
Linde Air Products Co., Div. of Union Carbide and Carbon Corp.	621
Lindsay Chemical Company	658
Minneapolis-Honeywell Regulator Company	614
Mullite Refractories Company	651
Nitrogen Division, Allied Chemical & Dye Corp.	655
Olin Mathieson Chemical Corp., Industrial Chemicals Division	615
Overmyer Mould Company	624
Pacific Coast Borax Company	653
Palmer & Associates, Delos M.	648
Raytheon Manufacturing Company	648
Sharp-Schurtz Company	664
Solvay Process Div., Allied Chemical & Dye Corp.	657
Stauffer Chemical Company	650
Surface Combustion Corp.	Cover IV
Taylor Sons Company, Chas.	Cover III
Toledo Engineering Company	652
Union Carbide and Carbon Corp., Linde Air Products Co. Division	621
Walsh Refractories Corp.	656
West End Chemical Company	649
Westvaco Chemical Div., Food Machinery & Chemical Corp.	625
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp.	616
Wyandotte Chemicals Corp.	666

Key Points Where It Pays to Specify B&W Specialized Refractories



Operators of glass melting furnaces know best the properties of refractories that they need in various tank locations.

Many manufacturers are choosing B&W Allmul, Allmul-D, B&W 80, 80-D and B&W Junior Firebrick for ports, checkers, regenerator crowns and walls. B&W Insulating Firebrick are also used for those sections of the tank that may require insulation.

Individual choice of a particular brand for a specific area varies, of course, with kind of glass melted, rate of pull, design of unit and other operating considerations. A container manufacturer found that B&W 80's were the most economical for specific checker locations, while another, producing tubing uses B&W Junior Firebrick in similar checker areas. B&W 80 Firebrick are used in burner blocks of a tank producing pressed ware, while manufacturers of borosilicate, container and window glass, for like applications, use B&W Allmul.

The one common requirement in all these applications is the uniform need for B&W *specialized refractories* to provide adequate performance.

For your next tank rebuild, we suggest calling in your B&W representative to get complete details.

Properties of B&W's Specialized Firebrick

	B&W Allmul	B&W Allmul-D	B&W 80	B&W 80-D	B&W Junior
Recommended use limit, F	3200	3200	2950	2950	2850
Fusion point, F	3335	3335	3190	3190	3173
Hot load strength, % deformation, 25 psi, 1½ hours	Less than 2% @ 3050F	Less than 1.2% @ 3050F	Less than 1% @ 2640F	Less than 0.5% @ 2640F	Less than 1.5% @ 2640F

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
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GENERAL OFFICES: 161 EAST 42nd ST., NEW YORK 17, N.Y.
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B&W REFRACTORIES PRODUCTS: B&W Allmul Firebrick • B&W Silicon Carbide • B&W 80 Firebrick • B&W Junior Firebrick
B&W Insulating Firebrick • B&W Refractory Castables, Plastics and Mortars

B490

Index of THE GLASS INDUSTRY for 1955

A

Absorption of X-Rays, Glass for *Aug. p.* 421
Alaskites as Raw Materials for Glass Manufacture *July p.* 367
Alloy Insert Increases Thimble Life, Nickle Base *Sept. p.* 472
Analysis of Ancient Glass, The *July p.* 362
Analysis of Gas Bubbles in Glass *July p.* 366
Ancient Glasses, The Analysis of *July p.* 362
Annealing of Glass by T. M. Lehrs *Dec. p.* 643
Armstrong Uses Fusion-Bonded Alloy Castings on Glass Blank Molds *Mar. p.* 145
Automatic Machines and Manpower Attain High Production Level at CBS-Hytron *Apr. p.* 198
Automatic Regulation of Pressure in Glass Furnaces *Feb. p.* 88

B

Basic Refractories in the Glass Industry *June p.* 313
Batch Briquettes Bound with Slacked Lime *Mar. p.* 146
Book Reviews: Glass Reinforced Plastics *Feb. p.* 104; Optical Glassworking, *May p.* 272; Petrographic Mineralogy *July p.* 391; Handbook of Engineering Materials *Sept. p.* 489
Booster Melting Electric, Current Status of *Dec. p.* 635
Boric Oxide, Influence of *Jan. p.* 35
Bottle Glasses, Comparison of the Surface Durabilities of Some Commercial *Oct. p.* 515
Bubbles and Blisters in Glassware, Examination of *Mar. p.* 151
Bubbles, Gas, The Analysis of In Glass *July p.* 366
Bubbles In Glass—The Problem and Some Approaches to Its Solution *July p.* 357
Bubbles, Open, The Mechanism of Formation of *July p.* 368

C

Calcium in Glass, The Determination of by Flame Photometry *Mar. p.* 255
CBS-Hytron, Automatic Machines and Manpower Attain High Production Level *Apr. p.* 198
Chemical Durability of Alkali-Lime-Silica Glasses, Effect of Na_2O/K_2O Ration on *Nov. p.* 589
Comparison of the Surface Durabilities of Some Commercial Bottle Glasses *Oct. p.* 515
Conductivity, Electrical, of Solid Glasses *July p.* 369
Conference on Glass Problems, Fifteenth *Jan. p.* 23
Containers, National Advertising for Glass *June p.* 305
Coppering of Glass Ornaments *Aug. p.* 421
Cows Find Contentment in Glassed Barn *Mar. p.* 139
Cracking Velocity of Glasses *Mar. p.* 133
Current Statistical Position of Glass *Jan. p.* 39; *Feb. p.* 99; *Mar. p.* 154; *Apr. p.* 214; *May p.* 274; *June p.* 324; *July p.* 377; *Aug. p.* 429; *Sept. p.* 484; *Oct. p.* 535; *Nov. p.* 590; *Dec. p.* 646
Current Status of Electric Booster Melting *Dec. p.* 635
Czechoslovakian Papers of Interest to the Glass Industry: Translations *Aug. p.* 421

D

Defects in Plate Glass Manufacture, Evaluation of Metal *Sept. p.* 465
Determination of Calcium in Glass by Flame Photometery, The *May p.* 255
Devitrification Behavior of Glasses Used in Vacuum Techniques *May p.* 262
Drilling of Glass *July p.* 368
Durabilities of Some Commercial Bottle Glasses Comparison of Surface *Oct. p.* 515

E

Eighteen Papers Presented at Fall Glass Division Meeting *Oct. p.* 521
Electrical Conductivity of Solid Glasses *July p.* 369
Electric Booster Melting, Current Status of *Dec. p.* 635
Electric Lehrs, Forced Air Circulation in *Aug. p.* 417
Electric Melting of Glass, Equipment for *Aug. p.* 418
Electric Melting of Glass, Which Is Best-Induction Regulators or Saturable Reactors? *Jan. p.* 29
Electric Ovens, Temperature Regulation of *Mar. p.* 140
Electronic Valve Making, Some Glass Problems in Modern *Oct. p.* 531
Evaluation of Metal Defects in Plate Glass Manufacture *Sept. p.* 465
Export, German, of Glass and Glassware to North, Central and South America *July p.* 363

F

Factories, Some European: Operation, Trends, History *Apr. p.* 203
Fall Glass Division Meeting, Eighteen Papers Presented *Oct. p.* 521
Fiber Paper, Improved Glass *Oct. p.* 525
Fifteenth Conference on Glass Problems *Jan. p.* 23
Fining, Some Practical Aspects of Seeds and *Dec. p.* 637
Flame Photometry, The Determination of Calcium in Glass by *May p.* 255
Forced Air Circulation in Electric Lehrs *Aug. p.* 417
Furnace Instrumentation Pays Dividends *Apr. p.* 201
Furnace, Report on a New Post War *Aug. p.* 428
Fusion-Cast Refractory Block by γ-Radiography, Examination of *June p.* 322

G

Gas Bubbles, The Analysis of, In Glass *July p.* 366
German Export of Glass and Glassware in North, Central and South America *July p.* 363
Glass Annealing of by T. M. Lehrs *Dec. p.* 643
Glass Conference Papers, Summaries of *Aug. p.* 417
Glass Damage, Segmental Loading Reduces *Sept. p.* 468
Glass Division at Annual A.C.S. Meeting, Thirty-Three Papers for *Apr. p.* 191
Glass Division Program in Cincinnati; A Review of *June p.* 307
Glass Division Meeting, at Fall, Eighteen Papers Presented *Oct. p.* 521
Glassed Barn, Cows Find Contentment in *Mar. p.* 139
Glass Events, International *Aug. p.* 413
Glass, Equipment for Electric Melting of *Aug. p.* 418
Glass-Fiber Paper, Improved *Oct. p.* 525
Glass for Absorption of X-Rays *Aug. p.* 421
Glass Industry, The *Feb. p.* 75
Glass Mosaic Mural Feature of Los Angeles Civic Center *May p.* 257
Glass Ornaments, Coppering of *Aug. p.* 421
Glass, Theory of the Rate of Stress Release in Tempered *Aug. p.* 420
Glass Viscosity, Viscometer for Measuring *Sept. p.* 483
Glyoxal and Triethanolamine As a Reducing Agent *Feb. p.* 85
Great Britain, Teaching and Research in *Nov. p.* 583

H

Highly Transparent Glass From Glass Tanks *Mar. p.* 146
Hydrazine—Its Use in Mirror Making *Aug. p.* 413

I

Improved Glass-Fiber Paper *Oct. p.* 525
Induction Regulators or Saturable Reactors—Which Is Best for Electric Melting of Glass *Jan. p.* 29
Information Circulars of the Institute of Silicate Research *Apr. p.* 193
Infrared Transmission of Glass in Range Room Temperature to 1400° C. *May p.* 273
Instrumentation, Furnace, Pays Dividends *Apr p.* 201
Inter-Society, Color Council Annual Meeting *May p.* 260
International Glass Events *Aug. p.* 409
Inventions and Inventors:
- Annealing and Tempering: *Mar. p.* 147; *Apr. p.* 207; *July p.* 371; *Aug. p.* 423;
- Feeding and Forming: *Jan. p.* 32; *Feb. p.* 91; *Mar. p.* 147; *Apr. p.* 207; *May p.* 265; *June p.* 318; *July p.* 371; *Sept. p.* 477; *Oct. p.* 526; *Nov. p.* 582; *Dec. p.* 638
- Furnaces: *Mar. p.* 147; *Apr. p.* 208; *May p.* 266; *June p.* 318; *July p.* 371; *Sept. p.* 477; *Oct. p.* 527; *Nov. p.* 585; *Dec. p.* 638
- Glass Compositions: *Jan. p.* 33; *Mar. p.* 148; *Apr. p.* 209; *May p.* 266; *June p.* 319; *Aug. p.* 423; *Sept. p.* 477; *Oct. p.* 527; *Nov. p.* 585; *Dec. p.* 639
- Glass Wool and Fiber: *Feb. p.* 91; *Mar. p.* 148; *May p.* 266; *July p.* 372; *Sept. p.* 478; *Oct. p.* 527; *Nov. p.* 585; *Dec. p.* 639
- Sheet and Plate Glass: *Jan. p.* 33; *Feb. p.* 92; *Mar. p.* 150; *Apr. p.* 210; *May p.* 268; *June p.* 320; *July p.* 373; *Aug. p.* 423; *Sept. p.* 479; *Oct. p.* 529; *Nov. p.* 587;
- Tube and Cane Machines: *Feb. p.* 92; *Mar. p.* 150; *May p.* 268; *July p.* 374; *Aug. p.* 423; *Oct. p.* 529; *Nov. p.* 588; *Dec. p.* 652
- Miscellaneous Processes: *Jan. p.* 34; *Feb. p.* 94; *Apr. p.* 210; *May p.* 269; *July p.* 374; *Aug. p.* 23; *Sept. p.* 492; *Oct. p.* 542; *Nov. p.* 586;

K

Kinetics of Glass Formation, The *Feb. p.* 87

L

Lehrs, Forced Air Circulation in Electric *Aug. p.* 417
Lehrs, T. M., Annealing of by *Dec. p.* 643
Lithium Development and Expansion *Jan. p.* 17
Loading, Segmental Reduces Glass Damage *Sept. p.* 468

M

Meetings:
- American Ceramic Society
  - Annual Meeting *Apr. p.* 191
  - Glass Division *June p.* 307; *Oct. p.* 521; *Dec. p.* 636
- Conference on Glass Problems *Jan. p.* 23
- Glass Container Manufacturers Institute *June p.* 305
- Inter-Society Color Council *May p* 260
- International Glass Events *Aug. p.* 409
- Optical Society of America *May p.* 260
- Overmyer Iron Clinic *Nov. p.* 582
- Inter-Society Color Council *May p.* 260; Melting of Glass, Equipment for Electric *Aug. p.* 418

Melting, Current Status of Electric Booster *Dec. p.* 635
Mirror Making, Hydrazine—Its Use in *Aug. p.* 413
Moisture-Condensation Patterns on Glass and Crystalline Surfaces *July p.* 375
Molds, Glass Blank, Armstrong Used Fusion Bonded Castings on *Mar. p.* 145
Mosaic, Glass, Mural Feature of Los Angeles Civic Center *May p.* 257
Movement of Molten Glass in Molds *Sept. p.* 474

N

National Advertising for Glass Containers *June p.* 305
New Equipment and Supplies: *Jan. p.* 42; *Feb. p.* 100; *Mar. p.* 156; *Apr. p.* 216; *May p.* 275; *June p.* 326; *July p.* 379; *Aug. p.* 436; *Sept. p.* 486; *Oct. p.* 544; *Nov. p.* 591; *Dec. p.* 642
New Owens-Illinois Technical Center Opens, *Oct. p.* 520; *Dec. p.* 627
Nickel-Base Aloy Insert Increases Thimble Life *Sept. p.* 472

O

"Open Bubbles," The Mechanism of Formation of *July p.* 368
Optical Society of America Spring Meeting *May p.* 260
Overmyer Iron Clinic *Nov. p.* 582
Ovens, Electric, Temperature Regulation of *Mar. p.* 140
Owens-Illinois Technical Center, "Technically Speaking" about *Dec. p.* 627

P

Patents (See Inventions and Inventors)
Pegmatites and Alaskites as Raw Materials for Glass Manufacture *July p.* 367
Plate Glass Manufacture, Evaluation of Metal Defects in *Sept. p.* 465

Q

Quartz Sand for Grinding Sheet Glass *July p.* 369

R

Radiation, Thermal Transmissivity by *Nov. p.* 575
Raw Materials for Glass Manufacture, Pegmatites and Alaskites, as *July p.* 367
Recent Translations Russian Papers of Interest to the Glass Industry: *Feb. p.* 87; *Mar. p.* 146; *July p.* 366; *Sept. p.* 474
Reducing Agent, Triethanolamine and Glyoxal as a *Feb. p.* 85
Refractories, Basic, in the Glass Industry *June p.* 313
Refractories, Present-Day Usage of High Alumina, Fusion-Cast *Feb. p.* 97
Refractories, Thermal Emissivity of and Its Importance for Glass Furnace Operation *Apr. p.* 212
Refractory Block, The Examination of by γ-Radiography *June p.* 322
Relations, Vendor-Consumer *Nov. p.* 573
Replica Technique for Measurement of the Surface Durability of Glass *Apr p.* 212
Research Digest: *Jan. p.* 35; *Feb. p.* 97; *Mar. p.* 151; *Apr. p.* 212; *May p.* 273; *June p.* 322; *July p.* 375; *Aug. p.* 428; *Sept. p.* 483; *Oct. p.* 531; *Nov. p.* 589; *Dec. p.* 643
Research on Utilization of Spinel with Lower Valent Aluminum Ion as a Reducing Reagent of Glass *Feb. p.* 83
Review of The Glass Industry—1954 *Feb. p.* 75

S

Sand, Quartz, for Grinding Sheet Glass *July p.* 369
Seeds and Fining, Some Practical Aspects of *Dec. p.* 637

Segmental Loading Reduces Glass Damage *Sept. p.* 468
Sheet Glass, A Figure of Merit for *Feb. p.* 89
Sheet Glass, Quartz Sand for Grinding *July p.* 369
Silicones in the Glass Industry—A Progress Report *June p.* 316
Some European Factories: Operation Trends, History *Apr. p.* 203
Some Practical Aspects of Seeds and Fining *Dec. p.* 637
Speaking Technically about the new Owens-Illinois Technical Center *Dec. p.* 627
Spinel, Utilization of, with Lower Valent Aluminum Ion as a Reducing Reagent of Glass, Research On *Feb. p.* 83
Statistical Position of Glass: (See Current Statistical Position of Glass
Stress Release in Tempered Glass, Theory of the Rate of *Aug. p.* 420
Surface Durabilities of Some Commercial Bottle Glasses, Comparison of the *Oct. p.* 515
Surface Durability of Glass, Replica Technique for Measurement of *Apr. p.* 212

T

T. M. Lehrs, Annealing of Glass *Dec. p.* 643
Teaching and Research in Great Britain *Nov. p.* 583
Technical Center, New Owens-Illinois *Oct. p.* 520; *Dec. p.* 627
"Technically Speaking" about the new Owens-Illinois Technical Center *Dec. p.* 627
Temperature in the Vertical Shaft of a Sheet Glass Machine *Feb. p.* 89
Temperature Regulation of Electric Ovens *Mar. p.* 140
Theory of the Rate of Stress Release in Tempered Glass *Aug. p.* 420
Thermal Emissivity of Refractories and Its Imporance for Glass Furnace Operation *Apr p.* 193
Thermal Expansion of Silicate Glasses *Feb. p.* 87
Thermal Transmissivity by Radiation *Nov. p.* 575
Thirty-Three Papers for Glass Division at Annual A.C.S. Meeting *Apr. p.* 191
Translations: Czechoslovakian: *Aug. p.* 421; Russian: *Feb. p.* 87; *Mar. p.* 146; *July p.* 366; *Sept. p.* 474.
Triethanolamine and Glyoxal as a Reducing Agent *Feb. p.* 85

V

Vacuum Techniques, Devitrification Behavior of Glasses Used in *May p.* 262
Velocity, Cracking, of Glasses *Mar. p.* 133
Vendor-Consumer Relations *Nov. p.* 573
Viscometer for Measuring Glass Viscosity *Sept. p.* 483
Viscosity of Industrial Glasses *July p.* 369

X

X-Rays, Glass Absorption of *Aug. p.* 421

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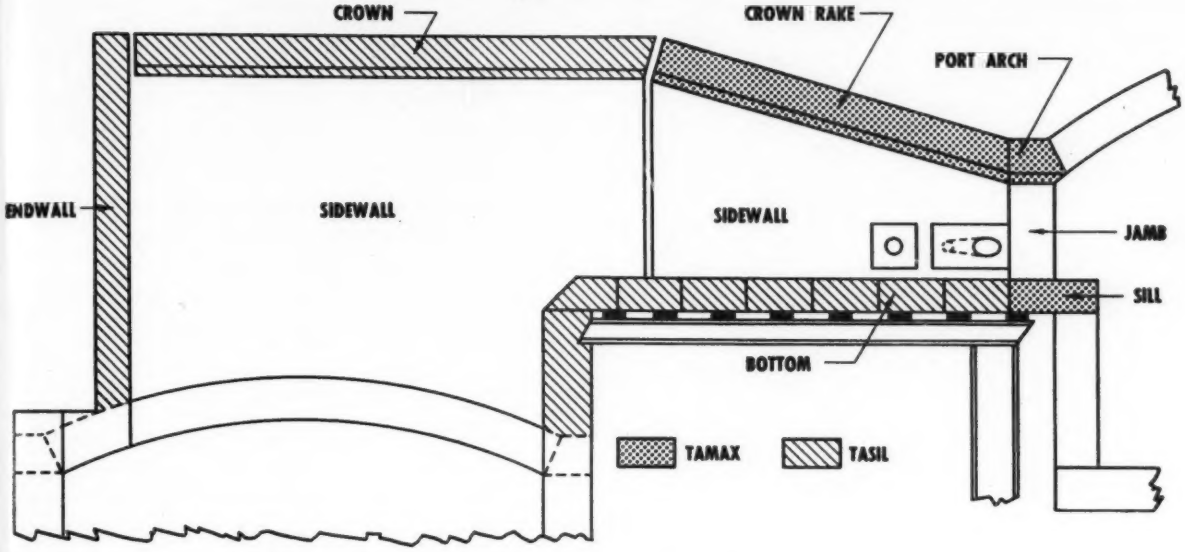

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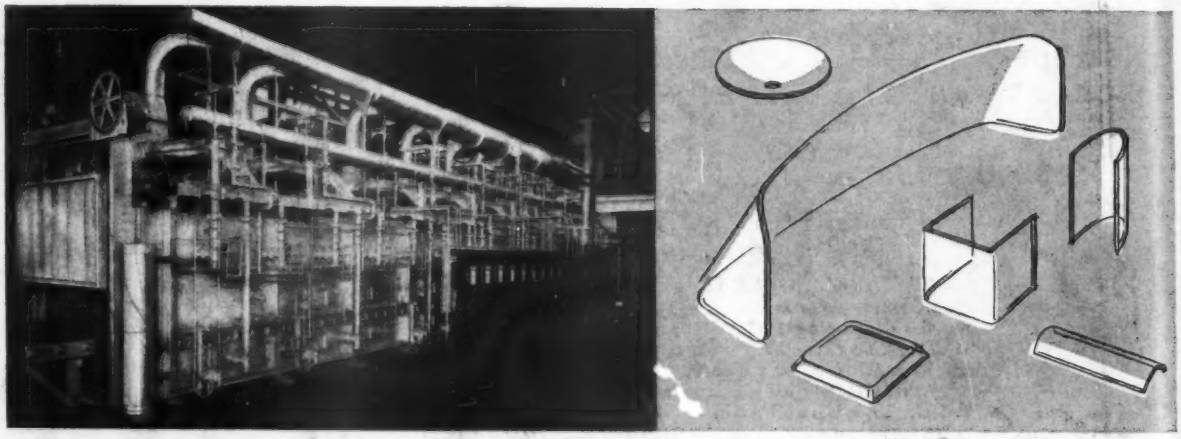

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